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AMERICAN FERN SOCIETY

EDITORS

R. C. BENEDICT

E. J. WINSLOW C. A. WEATHERBY

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American Fern Journal

VOL. 18 JANUARY–MARCH, 1928 No. 1

New Tropical American Ferns—IV[1].

WILLIAM R. MAXON

The three ferns here described as new are all from Costa Rica, and are of exceptional interest in their respective genera.

Rhipidopteris Standleyi Maxon, sp. nov.

Plants colonial, the rhizomes filiform (less than 0.5 mm. thick), extensively creeping, flexuous, sparingly branched, dark brown, angulate, deciduously paleaceous, the scales lax, oblique, subimbricate, mostly lance-attenuate, 2–3 mm. long, thin, dull fulvous, entire. Sterile fronds numerous, 1–2.5 cm. apart, erect, 1–3.5 cm. long, the stipe 0.5–2.5 cm. long, slender, laxly paleaceous, narrowly alate upward; blades simple, 0.8–1.8 cm. broad, roundish-obdeltoid to transversely oval or oblong, at base truncate or broadly cuneate and usually abruptly decurrent, the margins here entire; apical portion broadly rounded, evenly crenate, the teeth subequal 1–1.5 mm. broad, broader than long; venation flabellate-radiate, evident in drying, the vein-tips solitary within the marginal crenations; leaf-tissue rigidly herbaceous, scantily paleaceous, the scales of the lower side lance-deltoid, subpeltate, those of the upper side linear and tortuous. Fertile fronds few, 3–4 cm. long, the stipes filiform, 2.5–3.5 cm. long; blades simple, reniform, 7–

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[Volume 17, no. 4 of the JOURNAL, pages 111–146, plates 6 and 7, was issued March 1, 1928.]

10 mm. broad, subentire, or repand-crenate except at the re-entrant sinus, densely sporangiate, only the broad whitish margins naked.

Type in the U. S. National Herbarium, no. 1,215,446, collected on a wet mossy bank near La Hondura, Costa Rica, altitude about 1,300 meters, March 2–4, 1924, by Paul C. Standley (no. 36464). In company with Prof. Juvenal Valerio Mr. Standley collected also an excellent series of specimens in the general region of Tilarán and El Silencio, Province of Guanacaste, at an altitude of 500 to 750 meters, in January, 1926, his numbers being as follows: 44454, 44663, 44678, 45265, 45406, 45925, 46258; all these grew on the mossy trunks of forest trees.

A proper classification of the abundant material of *Rhipidopteris* found in American herbaria is difficult. Ordinarily three species are recognized: *R. peltata*, *R. foeniculacea*, and *R. flabellata*, all very much alike in type of venation but widely different in dissection, at least in their extreme forms. *R. foeniculacea* (Hook. & Grev.) Schott is probably best regarded as an extremely fine-cut form of *R. peltata* with nearly filiform divaricate segments; and even *R. flabellata* (Humb. & Bonpl.) Fée, which in its usually bifid or quadripartite sterile blades seems distinct enough from the well known *R. peltata*, is partially connected with the last by a recent series of Costa Rican specimens. Most distinct of all, however, is the plant here described, in which there is no indication whatever of lobing or dissection of the sterile blades. This form is abundant locally in western Costa Rica, often occurring to the exclusion of *R. peltata*, and on the basis of present material it may justifiably be accorded full specific rank; yet the entire series of *Rhipidopteris* specimens stands with very few unfilled gaps between *R. Standleyi* on the one hand and the most finely dissected states of *R. foeniculacea* of the South American Andes.

Psilogramme Jimenezii Maxon, sp. nov.

Rhizome short-creeping, woody, 3–5 mm. thick, scantily paleaceous, the scales brownish, oblique, subulate-attenuate, rather lax, about 1.5 mm. long, flattish and several cells broad in the basal portion, occasionally toothed toward the apex. Fronds several, approximate, apparently distichous, rigidly ascending from an arcuate base, about 20 cm. long, the stipes mostly shorter than the blades, dull castaneous, stout (2 mm. thick), glabrate; blades oblong-lanceolate, acute at apex, 11–15 cm. long, 4–6 cm. broad, nearly 2-pinnate, the pinnules pinnatifid; rachis stout, subflexuous, dull castaneous, greenish-marginate ventrally, striate dorsally and subfurfuraceous with short branched glandlike trichomes, at length scabrous; larger pinnae about 10 on either side, mostly alternate, subimbricate, spreading, subdeltoid, 2–3 cm. long, 1–1.2 cm. broad, with 3 or 4 pairs of distant, coarsely lobed or pinnatifid pinnules below the obtusish incised apex, these joined by a broadening wing; costae and costules glabrous above, subfurfuraceous beneath with short uviform glandulose trichomes; segments roundish, concave, with deeply recurved-revolute margins, the larger ones 2-lobed or 3-lobed; veins few, running to the emarginate lobes, there greatly enlarged; sporangia numerous, extending in a heavy line nearly throughout the course of the veins, mixed with minute yellowish glandlike hairs. Leaf tissue coriaceous, corrugate above, glabrous throughout.

Type in the U. S. National Herbarium, no. 865086, collected at the crater of Volcán Poás, Costa Rica, altitude 2,800 meters, February, 1915, by Otón Jiménez (no. 1034). A second specimen, received at a later time under the same number and with identical data, is *P. Warscewiczii* (Mett.) Kuhn.

Psilogramme Jimenezii belongs to the group of *P. hirta* (H. B. K.) Kuhn, and among North American species need be compared only with *P. Warscewiczii* and *P. congesta* (Christ) Maxon, of Costa Rica. *P. Warscewizii*, which apparently is common on Poás at 2,300

to 2,640 meters elevation (*Tonduz* 10712; *Donnell Smith* 6930; *Alfaro* 121; *Standley* 34857, 34869) and up to 3,200 meters on Volcán Turrialba (*Pittier* 13256; *Torres* 14; *Standley* 35033), is in general a much larger plant with wide-creeping rhizomes and blades glabrous above; it differs at once in its copious covering of long flexuous septate hairs beneath. *P. congesta,* which is abundant throughout the central table land and mountain regions at 1,300 to well above 2,000 meters, occurs also on the forested upper slopes of Volcán Poás at 2,500 to 2,640 meters, but this is immediately distinguished from *P. Jimenezii* by its thick multicipital rhizomes, cespitose fronds, and abundant long septate-hairy covering throughout, as well as in many minor characters. Neither of these species possesses the short uviform trichomes, with glandlike processes, which impart a glandular-scurfy appearance to the vascular parts of *P. Jimenezii* beneath. The complete absence of long septate hairs throughout is a conspicuous character of the new species.

Dryopteris Killipii C. Chr. & Maxon, sp. nov.

Rhizome short, stout, ascending, densely paleaceous, the scales suberect, tufted, bright brown, narrowly subulate-attenuate, 1–2 cm. long, rather thin, mostly involute or twisted, denticulate. Fronds 4 or 5, subfasciculate, suberect, about 2 meters long, the stipes slightly longer than the blades, stout, yellowish-brown, lustrous, strongly paleaceous, the scales persistent, rufous-brownish, thin, lanceolate, hair-pointed, denticulate-fimbriate, the larger ones divergent, underlaid by numerous smaller, thinner, peltately affixed appressed scales, a similar covering of hairlike scales extending to all the rachises and to the costules and veins of the ultimate segments beneath; blades deltoid, acute, up to 1 meter long and 90 cm. broad, 4-pinnate-pinnatifid, the pinnae spreading; basal pinnae deltoid, acuminate, 45 cm. long, 30 cm. broad, stalked (5 cm.), inequilateral

though not strongly basiscopic, the proximal basal pinnule subdeltoid, 15–17 cm. long, 10 cm. broad, stalked (1.5–1.8 cm.), long-acuminate; pinnules of the third order ovate-oblong to triangular-oblong, acuminate, the larger ones 4–6 cm. long, 1–2 cm. broad, stalked (2–5 mm.); larger pinnules of the fourth order 10–15 mm. long, rather obtuse, obliquely incised nearly to the costa into 4 or 5 pairs of acutish ultimate segments, the larger of these often sharply toothed distally; basal pinnules of all orders nearly opposite, the upper ones alternate, those of the third and fourth orders inequilateral at base, the distal divisions elongate; costae and costules densely puberulous above with short brown intestiniform hairs, the upper leaf surface glabrous; under side of segments beset with very minute, thick, lustrous, yellow, glandlike hairs, freely so along the veins; sori few, distant, nearly confined to the distal side of the ultimate divisions, dorsal, the usually simple veinlet not attaining the apex of the sharply acute lobe; sporangia numerous, bearing a short-stalked yellow gland upon the pedicel; indusia large, coriaceous, roundish-reniform, glabrous, subpeltate. Leaf tissue firmly membrano-herbaceous, brownish in drying.

Type in the U. S. National Herbarium, no. 1,207,594, collected in humid forest of the Río Caldera watershed, west of El Boquete, Chiriquí, Panama, at an altitude of 1,900 meters, February 17–19, 1917, by Ellsworth P. Killip (no. 5360). The species is represented also by a second collection (*Killip* 5293) with nearly identical data, and by a single Costa Rican specimen (Santa Clara de Cartago, 1,950 meters, *Maxon* 8222); the latter, though small and sterile, is sufficiently complete to afford data as to rhizome characters and proportions of the frond.

Dryopteris Killipii is a strikingly distinct new member of the subgenus *Parapolystichum*. In general architecture it resmbles the common tropical American *D.*

effusa (Sw.) Urban and *D. exculta squamifera* C. Chr., of Costa Rica, but it differs strongly in its stout shaggy stipes and rachises, deltoid non-attenuate blades, minutely paleaceous segments, and large coriaceous indusia. In color and texture it recalls *D. macrostegia* (Hook.) Kuntze and *D. amplissima* (Presl) C. Chr., of South America, belonging to the subgenus *Polystichopsis*.

WASHINGTON, D. C.

Fern Ecology of Barro Colorado Island Panama Canal Zone

LESLIE A. KENOYER

Barro Colorado Island is the largest island in Gatun Lake, the artificial lake formed in 1914 to make up the central portion of the Panama Canal. Its highest elevation is 537 feet. In 1923 the island was set aside by the governor of the Canal Zone as a biological reserve. Subsequently a commodious and comfortable laboratory was erected on it. It has been visited by numerous biologists, who find in its six square miles of forested area and along its twenty-five miles of shore line a wealth of material for research in tropical biology.

The region is a tropical rain forest of a somewhat dry type, i. e. including a number of periodic or monsoon plant types. The annual rainfall is close to 115 inches. Half the area of the island is primeval forest, the remainder being second growth, with only an occasional small clearing.

Mr. Paul C. Standley (The ferns of Barro Colorado Island. AMERICAN FERN JOURNAL **16**: 112–120; **17**: 1–8. 1926, 1927) lists forty-four species of ferns and fern allies from the island. The writer by collections made during July and August added twenty-eight others, giv-

ing seventy-two in all. Determinations were made by Dr. William R. Maxon of the U. S. National Herbarium. The increase in the list is due in part to the extension of trails, there being now about thirty kilometers of trails, permitting access to almost every part of the island. It is also partly due to the opportunity for more intensive study. Eighteen of the added forms were collected within one kilometer of the laboratory. At the ravine crossing of one of the older trails, within 100 meters of the laboratory, were found eight previously unreported forms including a tree fern and a filmy fern. Up to the very end of the writer's stay, visits to new ravines revealed undiscovered species. So it is probable that the number will reach at least one hundred, which is a very good showing for a lowland tropical area.

CLEARINGS

Very few ferns are found on clearings. The most characteristic is *Lygodium polymorphum*, which climbs freely over weeds and shrubs. On a few exposed clearings along the shore may be seen the snowy *Pityrogramma calomelacna*, the thicket-forming gleicheniaceous *Dicranopteris flexuosa*, or the coarse mat-forming club-moss, *Lycopodium cernuum*.

PIONEER FOREST

The absence of big trees would seem to indicate that the greater part of the eastern half of the island was in cultivation up to about fifty years ago. Apparently the commonest ferns here are the tall pinnate *Cyclopeltis semicordata* and the rather low but coarse *Tectaria martinicensis*. Several species of Adiantum, especially *A. petoliatum* and *A. lucidum*, are frequent, and there are also invaders from the climax forest. Epiphytic ferns

are beginning to occupy the tree trunks and branches. *Lygodium polymorphum* has been replaced largely by *L. radiatum*, which climbs to considerable heights.

CLIMAX FOREST

The climax forest occupies the whole western half of the island. A walk of a kilometer on the trails brings one in sight of about 250 trees having a trunk diameter equaling or exceeding 0.6 m. (2 feet). Ferns constitute a prominent part of the undergrowth. On the forest floor, outside of the ravines, the largest forms are *Cyclopeltis semicordata* and *Diplazium grandifolium*, which have pinnate fronds attaining a height of about a meter. Adiantum is a ubiquitous genus, including *A. petiolatum*, *A. lucidum*, *A. villosum* and *A. obliquum*. *Pteris propinqua* frequently lifts its large ternate leaf somewhat suggestive of *Pteridium aquilinum*. Other species are *Pteris pungens*, *Asplenium falcinellum*, *Diplazium grandifolium*, *Diplazium delitescens*, *Dictyoxiphium panamense*, *Dryopteris dentata* (Standley's paper), *Dryopteris Poiteana*, *Maxonia apiifolia*, and *Tectaria martinicensis*. *Selaginella haematodes*, with its bright red stems, is occasional and *Selaginella conduplicata* frequent in the forest.

RAVINES

Ravines are par excellence the home of ferns. Here are found two interesting tree ferns. *Alsophila tenerifrons* attains a height of ten meters and a trunk diameter of 0.2 m. *Hemitelia petiolata* is a graceful form three or four meters high. *Danaea nodosa*, the only marattiaceous fern noted, is said by Standley to be common in ravines, but the writer found it only on the banks of a ravine in the Shannon Trail. It is a tall coarse fern with swollen nodes on the rhachis. *Cyclo-*

peltis semicordata is particularly abundant on ravine banks, forming an almost pure stand in places. *Pteris grandifolia* is the largest polypodiaceous fern, having a once pinnate leaf four meters in length. *Dennstaedtia rubiginosa* has a thrice pinnate leaf. *Dryopteris Sprengelii* has a short upright trunk suggestive of the tree ferns. The three last forms were found only in a deep ravine crossed by the Pearson Trail about a kilometer from the laboratory. *Dryopteris sordida*, found very near the laboratory, had not before been reported for any locality south of Guatemala. *Saccoloma elegans* is a unique type with sporangia in pockets along the margins of the leaflets of the once pinnate leaves. *Leptochilus cladorrhizans* has the interesting habit of forming slender rooting runners from the tip of the frond. Other ravine ferns are *Pteris Kunzeana*, *Asplenium lactum*, *Tectaria euryloba*, and *Hemidictyum marginatum*. On the rocky walls of a deep narrow ravine where the light was very diffuse was found *Trichomanes diversifrons*, a fine large plant of the *Hymenophyllaceae*.

ERODING SHORES

Dicranopteris flexuosa, one of the Gleicheniaceae, and the rankly growing *Lycopodium cernuum* are associated on exposed shores forming a dense tangle. The only locality noted for *Alsophila microdonta* is of similar character. The most xeric form of the region is probably *Pityrogramma calomelaena*. It is snowy white underneath, suggesting the temperate *Notholaena dealbata*, and is found on sunny clay banks and dry rock cliffs. *Selaginella Fendleri* is found on some of the semi-exposed shores. In more sheltered situations on overhanging rocks may be seen *Nephrolepis pendula*, a long drooping form closely allied to the well-known Boston

An exposed lake bluff, covered principally with Dicranopteris flexuosa, a gleicheniaceous fern. In the lower left corner is the tree fern, Alsophila microdonta.

Acrostichum daneaefolium growing with the cat tail (Typha angustifolia) on a small submerged island in Gatun Lake on the side of Barro Colorado Island opposite the canal.

Fern. Associated with it were *Blechnum occidentale* and *Polypodium percussum*.

WATER AND SWAMP

The only water fern, *Salvinia auriculata*, occurs floating on some of the still bays on the south and west sides of the island. The most conspicuous and widespread of the marsh ferns is *Acrostichum daneaefolium* with very coarse pinnate leaves one to two meters in height. Pure associations of this fern were noted in the Canal Zone, but around Barro Colorado island it is found mainly along shores and on little submerged islands associated with *Typha angustifolia* and other aquatics, in a characteristic hydrarch pioneer association. With it may frequently be found *Dryopteris serrata*, *D. gongylodes*, and *Nephrolepis biserrata*.

EPIPHYTES

In the epiphytic flora ferns figure very conspicuously. There are two fairly well-marked groups,—those with clustered fronds and those with fronds scattered along an extensively trailing rhizome. Among the former the prominent genus is Polypodium, recognized by the round fruit dots without indusium. *P. phyllitidis*, in aspect similar to a bird's-nest fern, is frequent, although previously unreported. *P. crassifolium* has the most extremely xeric leaf. Leaves of this plant lay for a month in the hot dry attic of the laboratory before withering commenced. Other species are *P. percussum* (occasional), *P. costaricense* (very common on trunks and branches), and an unidentified species of the *P. pectinatum* group. *Asplenium serratum*, the American birds'-nest fern, is a frequent and beautiful form. Also very frequent is *Eschatogramme furcata* with its interesting staghorn-like fronds. *Nephrolepis pendula* is

found hanging from horizontal branches high in the larger trees. *Vittaria lineata* has very long slender leaves which, tufted like grass clumps, hang from the branches in the forest. *Ananthacorus angustifolius* has similar but shorter and broader leaves. *Anetium citrifolium* has a characteristic simple obovate leaf. Several filmy ferns, small species of Trichomanes, grow on the bark of trees. *T. sphenodes* was collected by the writer, and *T. Godmani* as well as *T. Krausii* were noted by Standley. *Elaphoglossum Herminieri* is mentioned by Standley as an infrequent but conspicuous epiphyte. A single specimen of *Lycopodium dichotomum* was collected beneath a large tree from which it had fallen.

Of the ferns which have rhizomes extensively trailing or climbing upon tree-trunks, the most common is *Stenochlaena vestita*, with strongly differentiated foliage leaves and sporophylls. *Polypodium ciliatum* covers a considerable part of a large tree-trunk with its vine-like growth. Others are *Maxonia apiifolia*, *Leptochilus nicotianaefolius*, *Polybotrya villosula*, *P. osmundacea*, and *P. caudata*. The first three were collected by the writer as previously unreported forms, and the last two were noted by Standley but not by the writer. The trunk of a tree fern furnishes an especially good habitat for such forms.

The flooding of the Gatun Lake area has called forth new adjustments along the shore lines. The establishment of exposed shore pioneers along the eroding shoes has already been mentioned. Trees which were killed by flooding were, of course, originally occupied by epiphytic ferns. Most of these have died, due to peeling of the bark and to insolation. Only the more hardy forms have persisted, the most frequent being *Nephrolepis pendula*, *Vittaria lineata*, *Polypodium phyllitidis* and *P. crassifolium*. Water and marsh ferns have

invaded the area, occupying stumps which come to or nearly to the water surface. On certain of the higher stumps may be found almost an intermingling of these forms with the surviving epiphytes.

SUMMARY

1. Barro Colorado Island in the lowland tropical rain forest of the Panama Canal Zone has 72 known species of ferns and fern allies.

2. Very few of these species figure as clearing pioneers.

3. Ferns are frequent in second growth forest and abundant in primeval forest as underherbs, none of the upland forms being more than about one meter high.

4. Terrestrial ferns are most abundant in the ravines, where the flora includes two rather plentiful tree ferns.

5. A group of fern species is characteristic of the marsh formations in Gatun Lake.

6. There are numerous epiphytic ferns of both the tufted and the trailing types. Some of these are sufficiently resistant to persist on the exposed dead stumps in the lake.

WESTERN (MICHIGAN) STATE TEACHERS COLLEGE

Collecting Horsetails along the Way [1]

JOHN H. SCHAFFNER

The summer of 1927 was spent in taking a camping trip with my family to the Yellowstone National Park and although the main purpose was merely recreation and sight-seeing some botanizing was done and my special friends, the Equisetums, received their proper share of attention. Controlling the steering-wheel of an

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[1] Papers from the Department of Botany, The Ohio State University. No. 208.

automobile interferes somewhat with the recognition of the wayside plants, yet one can soon learn to recognize the proper habitats and to accumulate a respectable collection in his plant press.

We left Columbus, Ohio, on the second of July, which was not too late for finding most of the horsetails in good condition north of the 40th parallel. West of Elkhart, Indiana, several large patches of *Equisetum kansanum* showed up prominently on the railway which passed along the road. On the top of the railway track there were tufts of slender plants about 6 in. high, many of the shoots with tiny cones, while along the right-of-way there were typical plants 1½–2½ feet high. The dry railway seemed to make an ideal habitat for this somewhat xerophytic species. In the Dunes State Park of Indiana, with its remarkable sand dunes, and also east of Gary the more robust *E. laevigatum* was found. *E. arvense* was, of course abundantly distributed all through northern Indiana. Both *E. kansanum* and *E. arvense* are abundant along the highway near Joliet, Illinois, while a little farther on, at Aurora, *E. laevigatum* was again collected. At Dubuque, Iowa, only *E. arvense* was noted but farther west, at Waterloo, *E. laevigatum* was again seen in abundance. *E. arvense* and *E. laevigatum* seem to be the common species all through northern Iowa. The *E. laevigatum* often grows tall and robust with large prominently apiculate cones. It was also collected at Newell, east of Storm Lake. *E. kansanum* was seen at Cedar Falls, at Lake Okoboji, and near Larchwood. As one approaches the limit of the typical prairie, *E. laevigatum* becomes rarer and *E. kansanum* is the common species.

After passing over into South Dakota, *E. kansanum* was collected on clay banks along the road at Sioux Falls and at Salem. At Mitchell we visited the campus

of South Dakota Wesleyan College where the writer taught for a season many years ago when the country was still in its pioneer stage. Both town and college appear unusually progressive and up to date. *E. kansanum* was next collected in bare sandy soil in the Missouri River valley near Chamberlain. After passing through the Bad Lands, beyond Scenic, it was collected on the wet, sandy banks of the Cheyenne River. It will be noted that at each prominent climatic stage, westward, the species descends to a lower habitat. At Rapid City the influence of the Black Hills is manifest and here both *E. arvense* and *E. kansanum* were common.

On the road past "Game Lodge," the "summer white house" for 1927, we had the pleasure of getting a glimpse of President Coolidge himself. As his automobile passed ahead of ours he waved his hand in friendly greeting even though we were only "sage-brushers" and horse-tail hunters. In the Custer State Park of the Black Hills, *E. arvense*, *E. kansanum*, *E. praealtum*, and *E. silvaticum* were collected. The last named species was abundant at one place, in an open forest in sandy soil along a brook. It was not seen at any other place during the entire trip. Along the high, north-facing bluff of the creek at Spear Fish, *E. praealtum* was abundant.

Beyond this we passed into Wyoming through a gateway which bore the admonition, "Stop roaming, try Wyoming," and soon the weird form of the Devil's Tower came into view. There is a large, pure spring and a fine camping ground at its base. In the flood plain and banks of the Belle Fourche River, which we crossed by fording, *E. kansanum* and *E. arvense* were collected. At Buffalo, which is near the Big Horn mountains, *E. arvense*, *E. kansanum*, *E. laevigatum* and *E. praealtum* were present. The *E. laevigatum* was growing abundantly along the sandy banks of a creek and extended down into the water.

From Buffalo to Tensleep, the road extends over Muddy Pass, altitude 9666 ft. Here there were large snow fields still unmelted so we played snowball (July 14) and gathered the low alpine flowers. At a lower level *E. arvense* was observed. In this region the highland meadows are carpeted with blue lupine and purple larkspur together with many other flowers which make colorful patches contrasting wonderfully with the green coniferous forests.

At Tensleep, *E. kansanum* and *E. nelsoni* were collected on wet, sandy-gravelly island-bars in the creek. Finding *E. nelsoni* at this place was quite a surpise, but there it was with unmistakable characters, not to be confused with small tufted forms of *E. kansanum* or *E. laevigatum*.

We arrived at Cody rather early in the afternoon and after pitching camp I wandered down along the Shoshone River, hoping to find a suitable habitat for some Equisetum at this low level. After walking a long distance and being just at the point of giving up the search, I found *E. kansanum* growing in the water-soaked bed of an overflow channel in the flood plain.

In the Yellowstone National Park, because of its high altitude, *E. arvense* is abundant in many places. One day as I was walking up a little slope of the creek gorge above Tower Falls, the ground was carpeted with this species and noticing a path up through it, I decided to explore the place for others. After going a few rods, I suddenly met a large, sleek black bear. I had not yet become accustomed to bear and meeting one alone in the woods was a new experience for an Equisetum collector. I looked at the bear and the bear looked at me. We both seemed to arrive at the same general conclusion. He turned back and went up the slope and I turned back and went down the slope. I concluded that there might be some interesting Equisetums in another direction and

surely enough down at the bottom was a fine patch of *E. kansanum* growing in rich leaf mold with sand beneath and somewhat shaded by conifers. Several of these plants had surviving bases of 1 or 2 internodes, of the previous season's shoots, down in the leaf mold. This is unusual and was probably due to an early and deep snow cover during the previous winter. Had it not been for the bear this interesting patch might have been overlooked. After one of these friendly animals had tried to carry away our sack of sugar, my urban timidity gave way to a feeling of familiar contempt and indifference. Along this gorge, both above and below Tower Falls, *E. hiemale* is abundant. This species, along with other Pacific Coast plants, comes over, through the region of the national boundary, into Glacier National Park and evidently extends north and south along the mountains from that point for some distance. The specimens from Tower Falls have the normal characters for *E. hiemale* and are readily distinguishable from our eastern *E. praealtum*. The species grows abundantly in the deep wet misty gorge below the falls. I had collected some shoots and was sitting on a rock examining them with a hand lens when a lady from Utah, who was passing by, called out: "Now you *will* see snakes." She called the scouring rush "Snake-grass" and said that when a child they had a superstition that wherever Equisetum grew snakes would surely abound. Earlier on the present trip a boy from Wisconsin whose father was also botanizing had told me that the boys at home always called it "Snakeweed." I had never heard these names before although they appear to be common in widely separated regions. Britton and Brown give "Snake-pipes" as a common name for several species.

Along the creek below Mammouth Hot Springs, I collected *E. kansanum*, *E. hiemale*, and *E. variegatum*.

The last named species was growing in about the same kind of habitat as the *E. nelsoni* at Tensleep, namely on wet gravelly sandbars of the creek bed. Along the same creek near Gardner, Montana, several miles north, *E. hiemale*, *E. arvense* and *E. kansanum*, were collected Dwarfed specimens of *E. kansanum* were observed in a dry grassy meadow along the Firehole River, between Madison Junction camp and the lower Geyser Basin. Many of the fruiting plants were not over 4 in. tall. They were not tufted but were mostly single shoots growing out of the ground. Of course, the eruption of "Old Faithful" and other geysers distracted attention from Equisetum for a time and there were also comedies and tragedies. At West Thumb Camp while looking for plants at the margin of the hot spring area, I noticed a wild duck and five little ducklings, which had recently been scalded to death, floating in one of the hot pools. The next morning the three young members of the family wanted to see this wonder and after various surmises as to the cause of the tragedy we were returning through the pool district when suddenly before me stood a woman and her companion in tears of anguish. The lady was weeping violently as though she had lost her first born, and with the fate of the ducks fresh in mind I wondered whether some child might have fallen into one of the hot pools. Going up to find out the cause of the trouble it developed that their beautiful spotted bird dog had been missing since the evening before and there he lay well-cooked at the bottom of the deep hot pool—a heart-rending tragedy to the owner of the dog but somewhat of a comedy to an unsympathetic Equisetum fiend. After leaving the Park by the south entrance, typical *E. praealtum* and *E. kansanum* were collected along the Snake River. Here also were observed the small stunted forms of the latter species. growing in a dry short-grass plot, like those along the

Firehole River. A little farther south, along a brook margin, *E. arvense* was collected.

No horsetails were seen at Moran but we bought some gasoline at 40 cts. a gallon. Later we bought the same kind of gasoline in Kansas for 17 cts. At Dubois two species were present along the creek, *E. arvense* and *E. kansanum*. The *E. kansanum* was found on the moist creek bank and in an old dry, abandoned creek channel, growing together with the xerophytic sagebrush. It was probably receiving water through underground seepage from the creek. Here all gradations of semi-sterile cones were observed, from completely sterile shoots to normally large, fertile, cone-bearing shoots. A series of gradations of lengths of peduncles was also observed, ranging from 0 to ¾ in. in length. The peduncles also varied from nearly pure green to yellow. The minute sterile cones are on shoots with slender tips while the large fertile cones are on robust tips. At Lander, *E. arvense* and *E. kansanum* were both abundant and the same two species were again collected 44 miles south-east along the Sweetwater River. At Rock River only *E. kansanum* was observed in the creek bottom.

At Laramie, we stopped long enough to see the University of Wyoming and to call on Professor Aven Nelson in his fine herbarium. I was much interested to learn that the day was an unusual one for Dr. Nelson, since it was his anniversary of forty years of service at the University. It was just 40 years before on July 25, that he had arrived in Laramie to begin his labors for the advancement of botanical science in a region just emerging from pioneer conditions. Wyoming was still a territory.

After passing into Colorado, *E. kansanum*, *E. praealtum*, and *E. arvense* were collected along the road from Lyons to beyond Estes Park. At Ft. Morgan, *E. laevigatum* was found on the sandy banks of the South Platte

River. The same species was seen at Wray, Colorado. In northwestern Kansas, at St. Francis, *E. laevigatum* was found on the wet sandy banks of the Republican River while *E. kansanum* was growing in a grassy creek bottom near swampy ground.

No more Equisetum was seen until we were going through the broad Republican River valley, north of Concordia, where tall *E. lacvigatum* was present in abundance along the road. Finally we arrived for a five-weeks' stay at our Prairiedell Farm, near Morganville, Kansas, where *E. kansanum* grows in suitable habitats on the upland, especially on clay banks and *E. laevigatum* on the flood plain of the Republican River. *E. praealtum* also grows along streams but is seldom found and the same is true for *E. arvense*. For over 30 years I have only seen *E. arvense* persisting in one spot. On the farm of my old friend, Jules Desjardins, is a perennial spring, flowing out of sandstone into a creek bottom, and here a few individuals of *E. arvense* struggle along through wet season and drought, from year to year, with some individuals of *Woodsia obtusa* as neighbors. They would have to travel many miles to find another suitable spot in which survival would be possible.

COLUMBUS, OHIO

A Note on Asplenium pinnatifidum Nuttall

F. W. KOBBÉ AND W. A. DAVIS

For some time the occurrence of *Asplenium pinnatifidum* Nutt. in New England has been questioned. In 1920 the Committee on Floral Areas of the New England Botanical Club stated (4) that, "*A. pinnatifidum* is reported from Sharon and Southington, Conn. The

specimen from Southington in the Gray Herbarium, however, is not *A. pinnatifidum*, but a state of *A. ebenoides* with obtuse segments; that record may be founded on an error in determination. There seems no reason to doubt the Sharon report."

Examination of the material in the Eaton Herbarium at Yale University, which includes the Bissell Collection, bears out this statement as regards the Southington specimens, and one from New Britain as well. In all cases the supposed *A. pinnatifidum* proves to be *A. ebenoides* R. R. Scott.

The Sharon specimens have generally been accepted as good *A. pinnatifidum* by fern authorities, and the species is listed from this station in most current floras and fern books. Material of the original collection made by Mr. E. I. Huntington was given to the senior author, who first reported the find (2, 3). Although the original determination was verified by other experts, it was never entirely satisfactory. A recent reexamination of the material has convinced the authors that this plant, also, is *A. ebenoides*. The somewhat irregular shape of the fronds, the dark rachis, and the limestone habitat have led them to this conclusion. This definitely eliminates *Asplenium pinnatifidum* from the New England flora.

As there does not seem to be any record of *A. pinnatifidum* from New York state, Blairstown, New Jersey, now stands as the most northeastern station for this species. A specimen from this station from the colony originally reported by Macy Carhart (1), and now in the Fern Society herbarium, (Sheet no. 2594), has been identified as *A. Trudelli* Wherry. As Wherry himself points out (5), this latter species is scarcely more than a form of *A. pinnatifidum*, or possibly a hybrid of it.

Consequently there seems no reason for omitting the Blairstown station from the range of our plant.

The distribution of *Asplenium pinnatifidum*, therefore, may be said to be from Blairstown, New Jersey, and Youngstown, Ohio, south to Cartersville, Georgia, and west to Mine La Motte, Missouri (6), a region which lies approximately between the 41st and 30th parallels of latitude.

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Recent Fern Literature

Professor Boris Fedtschenko has kindly sent us a copy of an excellent article by him on the altitudinal distribution of ferns in the mountains of Turkestan. That seems a long way off; but a glance at Professor Fedtschenko's pages reveals such familiar names as *Woodsia ilvensis*, *Cystopteris fragilis*, *Dryopteris Thelypteris*, *Asplenium Trichomanes*, and *Ophioglossum vulgatum*,—in all, 13 species which occur in the United States out of 23 listed.

There are six mountain systems in Turkestan, all but one of which reach, at their highest points, 10,000 feet or more; one rises 24,000. The Tian-Shan, on the frontier of China, has the moistest climate, the most forests, and, in consequence, the most ferns (18 species). The heights

reached by the ferns varies, of course, with different species, and the average attainment of all species varies, for climatic reasons, among the different ranges. It is not surprising to find that the nearly ubiquitous *Cystopteris fragilis* holds the altitude record of almost 15,000 feet—indeed, it is the only species hardy enough to penetrate to the alpine plateaus and peaks of the Pamir. Also, it is the only species found in all six ranges and it ascends higher than any other in all except the Tian-Shan, where, under conditions more favorable to most ferns, *Asplenium viride* equals it and *Botrychium Lunaria* is a good second. These facts may be not without significance as indicating, in its hardiness and adaptability, reasons for the almost unprecedently wide distribution of *C. fragilis*.[3]

It is a pleasure to receive another of Brother Victorin's excellent and, for anyone who knows French, most readable studies of the fernworts of Quebec. This, an illustrated pamphlet of 137 pages, deals with the *Equisetaceae*. As in the earlier papers of the series, the usual taxonomic keys and descriptions and the usual statements of habitat and local ranges are supplemented with an abundance of information and comment relating to the history, uses, geographic distribution, origin, habits, common names, etc., of the plants concerned. We learn, for instance, that the *Equiseta* are known to the inhabitants of French Canada as "Queue de renard," fox-tail; that *E. arvense* is one of the worst weeds in the alluvial soils along the St. Lawrence; that, though most species of the genus are injurious to cattle,

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[3] Fedtschenko, Boris. Zur vertikalen Verbreitung der Farne in den Gebirgen von Turkestan. 5 pp. Reprint, without indication of origin.

E. limosum is not and is eaten with special avidity by horses; that the sterile and fertile stems of *E. sylvaticum* can be distinguished late in the season by their shape, the former, in which the lower branches develop first, taking the form of a cone standing on its base, the latter, in which the reverse is the case, that of an inverted cone.

Bro. Victorin finds, with A. A. Eaton, that there are few real varieties among the horsetails, most of the variants so-called being merely growth-forms, which are often the obvious result of external conditions and two or more of which sometimes occur on the same rootstock. However, he freely recognizes such variants as forms, meeting possible criticsm with the remark that modern genetics have taught us the importance of studying minor variations and that "taxonomy must not forget that one of its functions is to supply the investigator with an exact and comprehensive terminology and with serviceable categories, without attempting to judge, in advance, of their absolute value." He regards as proper varieties *E. arvense*, var. *boreale* (Bong.) Milde, distinguished by its three-angled branches and of more northern range than the typical form, and *E. variegatum*, var. *Jesupi* A. A. Eaton (which, however, he transfers to *E. hyemale*). He finds, what no previous student of the group seems to have noticed, that American *E. palustre* differs from the European in the characters of the teeth of the sheaths and makes of it a new variety, *E. palustre*, var. *americanum*.

In general, Bro. Victorin is conservative in his classification. He refuses to follow Farwell in dividing *Equisetum* into two genera; and he retains Eaton's treatment of the east-American scouring rush as a variety of the European *E. hyemale*. In one case he probably carries the conservative tendency too far; the thing as to which students of the group are likely to dis-

agree with him most positively is his reduction of Eaton's *E. hyemale*, var. *intermedium* to the rank of form without a word of comment or explanation. This plant is treated as a separate species by Schaffner; in New England, at least, it has a very different range and a different soil-preference from var. *affine;* and the sheath-characters on which it depends would seem to be at least as strong as those on which Bro. Victorin founds his variety of *E. palustre.*

One closes with regret that this must be the last of the fernwort papers, the group having now been completely covered. The series, however, will go on through the flowering plants (an installment on the gymnosperms has already appeared) until, it is hoped, the whole vascular flora of the province has been treated.[1]

THE RANSIERS' TRIP.—Some people are lucky! They can sit down and plan what they would like to do,—the most ideal kind of trip imaginable,—and then they can go and do it. We can all make similar plans, but the opportunities to carry them out do not always so readily materalize. Just consider the following trip which the Ransiers have planned and which is already under way, and then send your congratulations.

A closed car with a trailer; in the trailer an electric ice box, the power for which is furnished by the mechanism attached to the wheels; in the trailer two comfortable beds and a good radio; destination, anywhere or all over the United States; object, to have a good time.

The above summarizes approximately just what the Ransiers are now carrying out. We shall hope to have some reports from them from time to time for the FERN

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[1] Victorin, Fr. Marie-, Les Équisetinées du Québec. Contr. Lab. Bot. Univ. Montréal 9. 1927.

JOURNAL so that we may share more definitely their experiences. By way of suggestion, a copy of the latest membership list of the Fern Society will be forwarded to them on the chance that they left theirs in Manlius, New York. Perhaps they will be able to see some of the Fern Society members as well as the ferns of the different parts of the country.—R. C. BENEDICT.

ACTIVITIES OF THE BRITISH PTERIDOLOGICAL SOCIETY.—In looking over some issues of the *British Fern Gazette*, I was interested to note that according to the most recent membership list of their society (1927), their organization numbered exactly one hundred and twenty-two, forty-eight of which are starred as new members since August, 1927. Of this number, only six were non-resident in the British Isles. Of these six, one was South African, one Canadian, one French, and three lived in the United States.

An examination of the tables of contents for the last six numbers (3 years) showed a series of articles practically exclusively concerned with matters relating to varietal forms of local British native ferns. Notwithstanding this, there were a number of items which have more general interest, such as one on insect pests of ferns,—the insects considered are also found in this country. Another article gives the history of the *Cambricum* variety of *Polypodium vulgare* from its first discovery by John Ray and the inclusion under binominal nomenclature as *P. Cambricum* Linnaeus to their present-day recognition of numerous sub-varieties. This suggests two questions, neither of them new: whether our local eastern Polypodium is to be considered as separate specifically from the European form; and second, what may be the fundamental basis of the undoubtedly recurrent types of leaf variation, like this ruffling and in-

creased division in the Cambrian type of variety. Regarding the first question, readers are referred to Prof. Fernald's thorough discussion in Rhodora (**24**: 125–142. 1922) under the title "Polypodium virginianum and P. vulgare," or to Mr. Weatherby's digest in the FERN JOURNAL (**13**: 14, 15. 1923).

In the United States with our younger, broader territory, our interests in fern study are naturally still concerned with the broader taxonomic questions of species differentiation and distribution. In England, these questions ceased to exist as problems long ago. Instead they deal intensively with a multitude of distinct sub-varietal forms of their limited number of native species. With us, our concern with varietal types usually stops with the collection of herbarium material, or perhaps the transplanting of the original form to some backyard fern garden. In England, their interest starts with the discovery of such a new type, and continues with its careful cultivation and propagation. Where the FERN JOURNAL may publish an account of the fifty to one hundred fern species native in some single state, the *British Fern Gazette* is likely to deal with an equal number of the varieties of a single species. Among some single species of British ferns, such as the hart's tongue, there have been named and described more varieties than there are distinct species in the whole United States.

This mass of vegetative sports offers a most interesting field for experimental genetic analysis.—R. C. BENEDICT.

"THE WORLD'S GREATEST CURIOSITY."—Some six years ago (vol. 11, p. 122 of this JOURNAL) Miss Marshall told of an enterprising tradesman in Toledo, Ohio, who was then selling at 25 cents each, bunches of a dozen or so stems of *Lycopodium lucidulum* under the name of "Aqua, the wonder fern." Recently, Dr. Wherry has

reported a somewhat similar case from Washington. There, salesmen went from door to door, vending plants of *Selaginella lepidophylla*, "obviously from Mexico, with the following label, amusing to anyone who recognizes the origin of the plant. Its alleged insecticidal properties seem due to a trace of some cinnamon-like perfume which has been added." Here is the text of the label; we do not reproduce its "scare-heads."

"World's Greatest Curiosity. Resurrection Plant or Rose of Jericho. Always Alive. Sempre Vivia. The Finest Decorative Plant yet Introduced. Grows Rapidly and Never Dies. Unique, Beautiful and Interesting. A Handsome Ornament for the House, Office, Conservatory. Mentioned by Isaiah in the Bible. This grand novelty was discovered in the Holy Land and found in the interior of Egypt. Place one in a dish of water and you can see it grow in 20 minutes. Cover it all with water for 20 hours, after it is open just cover the roots with water. Grows all the year round. Any time you want to move throw the plant in the sun and it will roll up again in a dry ball. Place one of the dry balls in your trunk or valise and it will perfume your clothing and will destroy all insects. Price 25c straight."

ONE JOYFUL AFTERNOON AND ITS SPOILS.—Late in the fall of 1924, Miss Kittredge and I made an excursion to a mountain about a mile from town (Proctor, Vermont), which resulted in what we then thought two first-finds, and most fortunate did we count ourselves as we bore our treasures home.

Miss Kittredge was triumphant in the find of the most wonderful Christmas fern we had ever seen or heard of. We afterwards learned it was *Polystichum acrostichoides*, forma *multifidum* Clute. We were at first informed that it had been found but once before and that

"SKELETONIZED" AND NORMAL FRONDS FROM THE SAME ROOT OF LADY FERN.

in 1906 in Connecticut, but later learned that several other stations had been reported, and that Mrs. H. E. Heselton had discovered it ten years before in Vermont, at Barnard.

As we were hurrying jubilantly home with this precious find, I came upon what appeared to be *Athyrium Filix-femina*, but what I pronounced to be a skeleton fern. The leaf-tissue of the fronds was so reduced that little was left but the veins. It looked as if it were decaying, or had been eaten, but so unusual that I brought it home and set it out in my fern garden. The next spring it produced the same sort of fronds; I gave some to Mr. Weatherby, who thought it might be pathological.

It has continued, however, to produce the queer fronds. Last fall I moved to another part of the town and removed my ferns to some real woods adjoining my house. The "Skeleton Fern" is thriving beautifully; there its color is very noticeably darker than that of others of its species.

It usually has some nearly or quite normal fronds, as well as skeletonized ones; in at least one year (1927; I had not noticed before) the normal ones came later in the season. The accompanying illustration shows the two kinds.

Has anyone come upon this form before?

A later trip to the same section of the mountain rewarded us with a most interesting *Dryopteris cristata* × *marginalis* growing from a crevice of a boulder in a large open space. I do not recall that either parent fern was in sight, but this I cannot state with certainty.—MAUDE L. CHISHOLM, *Proctor, Vermont.*

IMPERFECTLY CIRCINATE VERNATION IN FERNS.—Apropos of my note on this subject (in this JOURNAL, vol.

16, p. 109) Mr. H. B. Dobbie calls my attention to the fact that he recorded this phemonemon in *Pellaea rotundifolia* in his book on New Zealand Ferns, p. 160. He adds that it is very marked in the small tree fern, *Dicksonia lanata*, extending even to the side pinnae, and occurs, less markedly, in *D. squarrosa*. It would appear, then, that fiddle-heads are not an invariable character-istic of ferns, but may be occasionally replaced in members of any division of the family, by a method of growth more like that usual in other plants.—C. A. WEATHERY.

SOME FERNS OF EASTERN VICTORIA.—Genoa is a small village with a couple of hotels and a post-office, about 90 miles from Orbost and about 320 from Melbourne, on the main tourist route from Melbourne (Victoria) to Sydney (New South Wales). The country there is rather mountainous; the vegetation consists chiefly of Eucalyptus and many species of the climbing order of plants. Near there, in two moist gullies, I noticed *Dicksonia antarctica, Lomaria discolor, L. lanceolata, Todea barbara, Blechnum cartilagineum, Adiantum aethiopicum, Pellaea falcata, Gleichenia circinata*, and *Asplenium flabelliforme.*

From there I motored back to Bellbird, a small hotel built near the creek of the same name, and from it explored Ericsson's Creek and gully. There I saw *Dicksonia antarctica, Alsophila australis, Dryopteris decomposita, Polystichum aculeatum, Lomaria discolor, L. Patersoni, L. capensis, L. lanceolata*, and *Blechnum cartilagineum* in abundance, while clustered and hanging from the trunks of the tree ferns were *Polypodium australe, P. diversifolium, P. pustulatum* and *P. grammitidis*, also *Polystichum adiantiforme* and *Asplenium flaccidum* and the tiny filmy ferns *Trichomanes venosum, Hymenophyllum australe* and *H. flabellatum.* In some

cases I saw three different species growing on the same tree fern. The growth of the epiphytic species was most noticeable where the track winds about through the tree ferns in the darkest recess of the gully. Further up the gully were seen *Davallia dubia*, *Gleichenia flabellata*, and *G. laevigata*, while growing among the vegetation on the ridge were found *Gleichenia dicarpa*, *Lindsaya linearis*, the common bracken, *Pteris aquilina*, and *Hypolepis rugulosa*.

From there I explored Bellbird Creek and noticed, in addition to species previously seen, *Asplenium bulbiferum*, *A. umbrosum*, *Pteris incisa* and *P. tremula*. Many epiphytic species were also seen here, growing on the tree ferns.

I left by the service car for home, after spending a most enjoyable time among the ferns.—ALLAN MACCASKILL, JR., Coleraine, Victoria.

AMERICAN FERN SOCIETY

Report of the President for 1927

It is a pleasant duty to report another good year for the Society. Our satisfactory condition is sufficiently shown in a steadily increasing list of members and the varied content of our quarterly publication, which rarely has contained matter of greater interest to the members generally. There is still needed, however, an increase in the number of contributors, and to this end it is again urged upon members to send in numerous short notes, whether in the form of queries, field observations, incidents of exploration, or minor problems of classification. The Editors are devoting their best efforts to the JOURNAL, and the Council of the Society is aiding in so far as it may, by allotting funds for extra pages and illustrations. What the JOURNAL shall afford in the way of interest and usefulness to its readers lies, neverthe-

less, chiefly with the members at large, every one of whom should be a prospective contributor to its pages. The point is by no means a new one, and has been stressed repeatedly.

Attention may very properly be called also to the new arrangement, in force during 1927, by which the mailing of the JOURNAL has been done by our publisher and the great accumulation of extra numbers been given fire-proof storage at the Brooklyn Botanic Garden, by courtesy of the Director and Board of Trustees. The plan has proved very advantageous to the Society. Some idea of the burden previously borne by Mr. Winslow in storing all back numbers for 16 years may be gained from the fact that in its present quarters this material occupies more than 120 pigeon-holes, each 8 by 12 inches across. Not only the item of storage, but the selection and mailing of numbers from this stock for so many years demand a further expression of appreciation and thanks to Mr. Winslow on the part of the Society.

Other features of interest are covered by the reports of the other officers, which indicate a prosperous and successful year ahead of us.

Respectfully,

WILLIAM R. MAXON, *President.*

Report of the Editors for 1927

The editors look back with pleasure on still another prosperous year for the JOURNAL, marred only by a combination of circumstances which made number 4 very late. With an extra appropriation of $40 from the Council, generous gifts from Messrs. R. A. Ware, T. C. Palmer, and Harry W. Trudell and from Dr. E. T. Wherry, and aid from the Brooklyn Botanic Garden in procuring photographs, we have been able to publish the

record number of 146 pages, including seven plates and a text figure. We have realized our ambition to run the index and purely business matter relating to the Society on additional pages, leaving nearly all our regular allotment for our contributors. They have furnished copy of good variety and excellent quality. We realize, as always, that what the JOURNAL may achieve is due to them; and we look forward thankfully and confidently to a continuation of their active interest in the future.

The arrangement for mailing the JOURNAL direct from the printers' has worked well. The storage of back numbers at the Brooklyn Botanic Garden has not only relieved us of anxiety and insurance fees, but, through the kindly interest of the Garden authorities, has brought with it unexpected collateral advantages, such as valuable exchange advertisements in *Ecology* and the *American Jaurnal of Botany* and other opportunities for making the Society known to a wider circle of prospective members than we could otherwise reach.

One prospect to which we especially look forward is the reprinting, as a supplement to the JOURNAL, of Dr. Water's key to the northeastern ferns based on their stipes. This very original piece of work, especially helpful in naming sterile specimens, has been for some time out of print; to make it available again will, we are sure, prove of interest and useful to our members.

R. C. BENEDICT,
E. J. WINSLOW,
C. A. WEATHERBY,
Editors.

Report of the Curator

Since my last report, the following accessions to the Society herbarium have been received and numbered: From C. E. Waters, 1439 mounted specimens; Miss Elmira E. Noyes, 161, mostly mounted; Mrs. L. R.

Cornman, 35; Rev. F. W. Gray, 54; E. W. Graves, 75; D. LeRoy Topping, 121; J. C. Nelson, 5; Rev. G. L. Moxley, 2; donor unknown, 11. The total number of sheets in the herbarium is 5216. Several other accessions have been received and will be reported as soon as the specimens are mounted and the sheets numbered.

A leak in a steam pipe where it could not be seen has ruined about 100 sheets in the genera Equisetum, Lycopodium and Isoetes. Members who have duplicates or can collect specimens in these genera are requested to send in such as they can spare to replace the ones destroyed.

The rather liberal use of the herbarium by members makes it necessary to state that those who care to avail themselves of this privilege are expected to pay transportation charges both ways, and that sufficient postage should accompany requests for specimens.

L. S. HOPKINS, *Curator.*

Report of the Judge of Elections

Rev. C. S. Lewis, Secretary, Trenton, N. J.

Dear Sir:—Herewith report on election of the American Fern Society.

ELECTION OF OFFICERS FOR 1928

President.	William R. Maxon, Washington, D. C.....	81	ballots
Vice-President.	Mrs. Carlotta C. Hall, Berkeley, Cal.....	81	"
Secretary.	Charles S. Lewis, Trenton, N. J.....	81	"
Treasurer.	J. G. Underwood, Hartland, Vermont.....	81	"

Total ballots cast, 81.

PHILIP DOWELL, *Judge of Elections.*

Mr. George K. Merrill, a former member of the Society and a well-known student of lichens, died at Rockland, Maine, October 21, 1927, aged 63. His herbarium, which contains a number of ferns, has been bought by the Farlow Herbarium of Harvard University.

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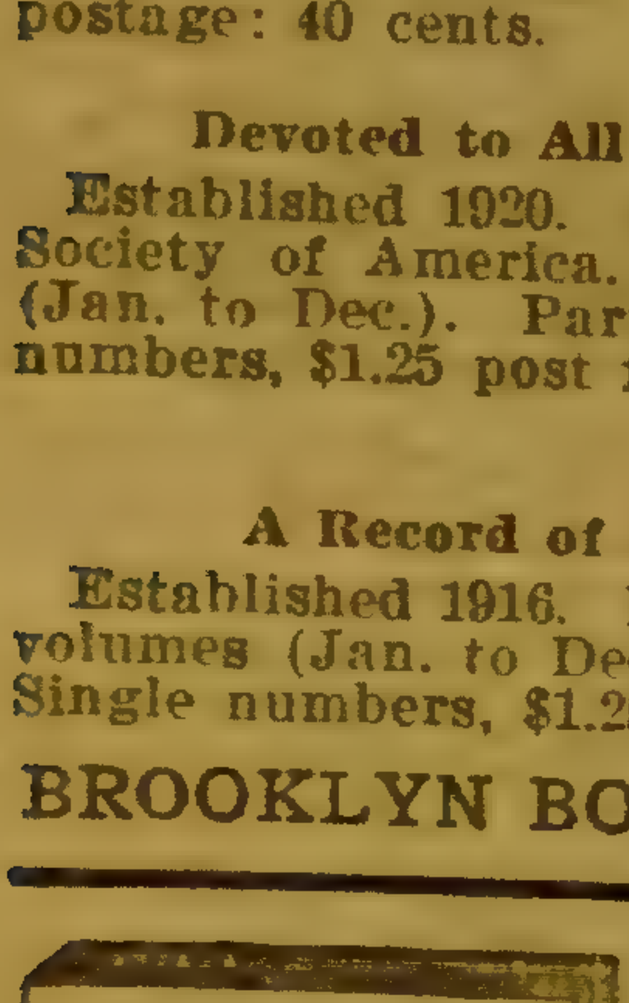

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Vol. 18 April-June, 1928 No. 2

American Fern Journal

A QUARTERLY DEVOTED TO FERNS

Published by the

AMERICAN FERN SOCIETY

EDITORS

R. C. BENEDICT

E. J. WINSLOW C. A. WEATHERBY

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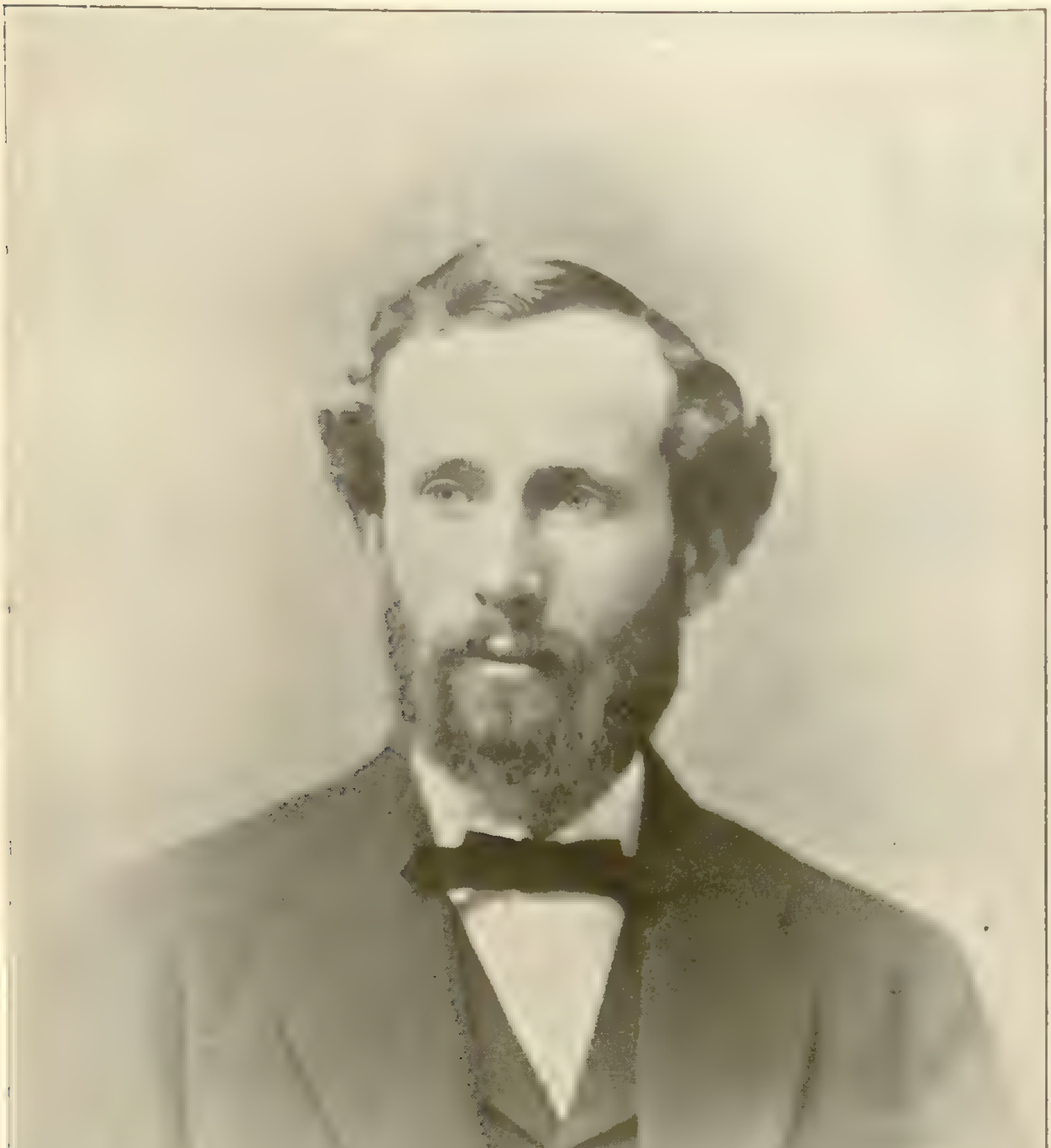

William Stout
(From a photograph in the collection of the Gray Herbarium of Harvard University.)

American Fern Journal

VOL. 18 APRIL–JUNE, 1928 No. 2

William Stout, a Forgotten Student of Ferns

C. A. WEATHERBY

Literary critics, I believe, argue that there can be no such thing as a "mute, inglorious Milton"; if one were really a Milton, he would not be mute. But, however, it may be with poets, botanists know that among them an analogous phenomenon can, and does, take place. Every now and then an amateur, known in his lifetime only to a small circle of friends and correspondents, dies, and there are found in his herbarium, or his note-books, or his letters, observations and comments showing a high degree of scientific attainment—better, sometimes, than much which finds its way into print. Such a case was that of **William Stout.**

A man of his quality does not often, let us hope, disappear quite so completely below the botanical horizon. Up to 1922 any one seeking information about him would have found in the *Botanical Gazette* a brief note stating that his herbarium had been given to Brown University, and perhaps a reference or two elsewhere in literature—nothing more. In December of that year, however, Miss Mary Elizabeth Davenport gave to the Gray Herbarium the personal fern collection of her father, George E. Davenport.[1] With the specimens were found a con-

[1] I say personal collection to distinguish it from the Davenport Fern Herbarium, a set of selected specimens of North American ferns which he got together and presented to the Massachusetts Horticultural Society, in whose building in Boston it is now preserved.

[Volume 18, no. 1, of the JOURNAL, pages 1–36, figures 1–3, was issued March 24, 1928.]

siderable number of letters and among them a series from Stout, of most unexpected interest. Of these I have already given some account (in *Rhodora* **26**: 52–55); it need only be said here, by way of recapitulation, that they showed that about 1879 Stout, an untrained amateur, starting with an attempt to name a specimen collected by himself in California, had gradually arrived at a classification of the difficult group of *Cheilanthes myriophylla* which in all essentials and in most details was quite like that worked out independently some forty years later by the experienced skill of Dr. Maxon. Stout submitted his revision to D. C. Eaton, Davenport, and J. G. Baker at Kew; after some fluctuation of opinion, all three rejected it, though in the end Davenport partially took it up in his herbarium. Stout himself refused to publish it.

In 1924 Miss Davenport generously added to her former donation the gift to the Gray Herbarium of the greater part of her father's botanical correspondence. In it are more letters from Stout, which, taken together with the others, form a fairly complete series from the beginning of his correspondence with Davenport in November, 1878, to his death some three and a half years later. These letters, with a few to Professor Eaton, very kindly loaned me by Dr. George F. Eaton, of New Haven, are the only source of information about Stout which I have been able to discover, though I have held this article for three years in the vain hope that something more might be found.

The letters do not yield much biographical matter; Stout was interested in ferns and wrote about them, not about himself. But they do give some facts. His father's name was Richard; he had a sister, Anna, and two brothers, Richard and George. He lived in New York City. He was of a consumptive tendency and dur-

ing the whole period covered by this correspondence more or less of an invalid. He often speaks of having to limit his activities because of lack of strength; in the photograph of him preserved among the Davenport papers and reproduced herewith by courtesy of the Gray Herbarium, his physical frailty is apparent. He was obliged to be away from the city during the extreme weather of both summer and winter; his working time must, therefore, have been confined to comparatively brief periods in spring and fall.

He was in California during parts of the years 1876 and 1877 and was able to do some collecting in the Yosemite and in the San Jacinto and San Bernardino Mountains. He cannot have done much before, for he speaks of having taken some of the California specimens when he had "no botanical interest." In the East he collected about Blue Mountain Lake in the Adirondacks and at Mt. Mansfield, Vermont, and somewhat in the mountains of North Carolina and Georgia, whither he regularly went for a part of each winter.

His personal collecting, however, like Davenport's, formed but a small part of his herbarium. Unlike Davenport, he did not confine himself strictly to ferns, but they were the chief objects of his interest. He bought and exchanged them eagerly and, so far as letter-writing would do it, was indefatigable in the pursuit of specimens he wanted. In the end, he got together an herbarium which included all but about half a dozen of the ferns then known from North America north of Mexico, and a large number of foreign species. And it was a critically determined collection, so far as he could make it so. "I like," he wrote, "to be *sure* of my specimens and am trying to learn, one at a time, to know the North American ferns thoroughly." He went at the job with earnestness. He studied his own specimens and

what he could borrow and sought collateral information from all available sources. One suspects, though no word of Eaton's hints at such a thing, that he may at times have been rather a nuisance to the good professor in his eagerness to find out what a given specimen should be called and especially why.

The opinions resulting from his studies he set down freely in the letters now at hand. They strengthen the impression given by the first series—that he was a man of keen observation, unusually sound taxonomic judgment, and an originality extraordinary in an amateur of so little experience. It kept him more or less constantly in protest against the too broad view of species prevalent in his time and the too frequent neglect of minute characters, such as the structure of the scales of the rhizome, which seemed to him—and rightly—of much significance. "The position Mr. Davenport has virtually taken," he wrote to Eaton in December, 1879, "that no good distinctive character exists in scales, is untenable & one which will embarrass him . . . & I doubt if he clings to it long. . . . The rhizome scales will determine mutilated, ill-conditioned & doubtful specimens of *P*[*olypodium*] *pectinatum* & *P. Plumula* & also *Asple*[*nium*] *parvulum* and *A. ebeneum*. I think when there is sufficient difference in the structure of the scales of two plants to make them always easily distinguishable by them that the character is just as good as if scales were present in one plant and absent in another—as in *Ch*[*eilanthes*] *Eatoni* and *Ch. tomentosa*." It seems curious now that such an argument should have been needed; but there was still occasion for it in Stout's time.

Stout's most complete and thoroughly worked out accomplishment was his treatment of the scaly *Cheilanthes* of the southwestern United States, already referred to.

His reasons for not publishing it are given in a letter to Eaton (Dec. 19, 1879). "It is not because I have any misgivings . . . nor because I have not the courage of my opinions that I must decline to publish the contemplated new species myself; but simply because I am unwilling to assume a position for which I am not qualified & for which my low state of health will prevent me from becoming qualified. I often suffer from over-application & study &, deeply interested as I am, I know I must hold myself free to lay the work down when I choose or when I must. Fond as I am of ferns I feel a reluctance to have them growing over me prematurely." The modesty and scientific conscience here shown, as well as the humorous turn with which he closes the matter, are characteristic. Another passage (from a letter to Eaton, Nov. 24, 1879) sets forth his point of view with a touch of rather engaging ingenuousness. "I would gladly be spared the friendly tilt I must have with Mr. Davenport about this matter & congratulate myself on the worthlessness of my opinion, as the consequences to me will be insignificant if I am proved in the wrong. It must be a fearful thing to be an authority, especially to be the highest authority."

But though Stout would not publish, he never gave up his opinion as to the Cheilanthes. Not long before his death he wrote to Davenport: "I doubt if the scaly Cheilanthes ghost will be laid till this plant [he refers to *Cheilanthes Covillei* of Maxon] is given specific rank." I think the collectors who were, for years after, haunted by it[2] would agree that it was not laid until this very thing was done.

It may be that the unfavorable reception of this revision somewhat discouraged Stout; in any case, it remains his most finished piece of work, as it was his first.

[2] See Maxon, Proc. Biol. Soc. Washington **31**: 139–140.

But there are, scattered through his letters, records of other bits of investigation which are worth preserving.

In 1880, he noted, at least partially, the differences among the dareoid Aspleniums of Florida, then referred to *A. myriophyllum*, which led to Davenport's (1883) and Eaton's (1887) segregation of varieties and later (1906) to Underwood's division of the plants concerned into three species, *A. Curtissii, A. biscaynianum* and *A. verecundum.*

He observed (1881) the appressed pubescence on the under surface of the pinnules of *Pteridium caudatum.* This, though absent in an occasional glabrate form, is one of the useful distinguishing characters of the group to which *P. caudatum* belongs; but no mention of it is found in the standard works of Stout's time. Hooker describes the plant as wholly glabrous.

Without knowing of Mettenius's publication, he distinguished *Pellaea intermedia* (1881) from *P. andromedaefolia* and *P. flexuosa,* to one or the other of which it was then referred, remarking that it was either *P. cordata,* which he knew only from description, or new. Davenport took up *P. intermedia* in 1886 and it has been generally recognized since.

He pointed out (1881) that a plant collected by Rusby in New Mexico and referred by Eaton to *Notholaena dealbata* was at least varietally distinguishable from that species by the larger size, proportionally narrower frond and more numerous pinnae. This is the plant treated by Maxon (1919) as subspecies *mexicana* of his *N. limitanea,* of the typical form of which only a tiny fragment was known to Stout.

He planned (1881) a study of the "mucronate Pellaeas," the group of *P. mucronata* recently (1918) revised by Maxon, but apparently never began the work.

He maintained (1882) that *Aspidium aculeatum*, var. *scopulinum* Eaton (*Polystichum scopulinum* Maxon) belonged with *P. mohrioides* rather than with *P. aculeatum*, indeed, that it was probably only a variety of the former. Davenport, regarding *P. scopulinum* as intermediate between the other two, apparently suggested that all three should be united under one species, for Stout writes to him: "I doubt if it is well, because it partakes of the characteristics of the two plants, to run them together. If the three plants were united under one name, could any specific description be written by which they could all be recognized? . . . I think too much lumping of related plants only tends to confusion and is, therefore, to be deprecated. . . . From what I have seen of the plants the only thing in *scopulinum* to separate it from *mohrioides* is its aculeate teeth, which again is really the only thing in it which strongly suggests *aculeatum*. Its indusium apparently agrees with *mohrioides* & here, I suspect, is a distinction from *aculeatum*. My impression is that the smaller plant has much the larger involucre, even if there be no other difference." Probably no one would now question the affinity of *P. scopulinum* with *P. mohrioides;* and the most recent investigator of the group (Fernald, 1924) has made precisely the disposition of it which Stout suggested, treating it as a variety of *P. mohrioides*.[3]

Stout's last work (1882) was a painstaking microscopic study of the indusia in *Woodsia*, with a view to the better arrangement of the species. Here, like others who have followed him, he arrived at no very definite conclusions. He thought it might be possible to distinguish, at least varietally, one other southwestern form in

[3] In speaking of *P. mohrioides* Stout very likely had in mind the Californian *P. Lemmoni* Underw., but this is so close to certain forms of the original South American *P. mohrioides* that the general correctness of his conclusions is not affected thereby.

addition to *W. Plummerae*—the plant, namely, distributed by Lemmon as *W. obtusa*, var. *nana*. He remarked that *W. scopulina* "seems to occupy a position so immediately between *obtusa* and *Oregana* that heaven is to be thanked for the minute, slender, jointed hairs it bears, which go a long way toward separating it specifically from its neighbors." He makes an observation on *W. oregana* which may be of some interest. "The whole texture of the plant seems to be resinous & the involucre is hard & brittle as though agglutinated & adheres to the lamina so that it is very difficult to remove it without fracture. *Mexicana*, on the other hand, yields its indusium in the same tractable way that *obtusa* usually does."

On June 19th, 1882, he wrote to Davenport that his work on the Woodsias was finished. On the night of June 23rd he "was seized with a severe hemorrhage & on the 28th he died very peacefully."

In three and a half years, with no previous experience, with wretched health and limited working time, Stout had perceived where lay most of the unsolved problems in the classification of our southwestern ferns (to which his attention was then particularly directed) and in several cases had anticipated the solution of them reached long afterward by other workers. It is, of course, to be emphasized in this connection that he held, to the end, to his habit of never making his conclusions in any way public; he merely set them down in private letters to Eaton or Davenport. Until I saw them, these letters had probably never been read by any one but their recipients; the most that was known of their contents was a vague hint as to the Cheilanthes in notes in the Eaton herbarium, duly recorded by Dr. Maxon. Other-

wise, the later investigators who, quite independently, duplicated Stout's conclusions, were hardly aware even of his existence. The remarkable thing is that he, with meager facilities, was able to proceed so far on the road which fern taxonomy was to follow after his time. Had he lived and had his health, there would have been much less left for the rest of us to do.

He left his herbarium largely unmounted. He says he spent so much time in studying his specimens that little remained for mounting or arranging them. In the four years following his death his sister filled up gaps in the collection and mounted and labelled the whole, which was then presented to Brown University, where it now is. Miss Stout has said that her brother rarely made notes; and faithful and devoted as she obviously was, she sometimes used her own judgment as to preserving those he did make. She wrote to Davenport that he had marked certain plants "new species"; "I did not add it, doubting as I did whether he would have done so now." So that one cannot be wholly sure that a given sheet at Brown is labelled strictly according to Stout's ideas or even that he saw it. But at least the specimens remain as a memorial to one who, under happier circumstances, might have ranked high among American pteridologists.

EAST HARTFORD, CONN.

New Tropical American Ferns—V.[1]

WILLIAM R. MAXON

The three species described herewith are from Jamaica. The first of them is evidently very rare, having been collected only once and in small quantity, and it is a special pleasure to dedicate it to Mr. C. E. Randall, from whose home, "House Hill," field work in the Cuna Cuna mountain region was carried out in the early summer of 1926, as elsewhere described.[2]

Polypodium Randalli Maxon, sp. nov.

Subgenus *Eupolypodium*. Plants epiphytic, small, very delicate. Rhizome erect, 2–3 mm. high, about 1 mm. thick, densely paleaceous at apex; scales lanceligulate, 0.7–1 mm. long, thin, yellowish-brown, reticulate, hair-pointed and sparsely long-ciliate (the hairs delicate, whitish, laxly curved), 6–10 cells broad near base; cells subrectangular, with very large lumina, the partition walls thin but definitely sclerotic, the outer walls hyaline. Fronds 5–12, laxly ascending, cespitose, 2–5 cm. long, exstipitate; blades linear or narrowly oblanceolate, 5–8 mm. broad, acutish at apex, acute or subattenuate at base, obliquely pinnatisect throughout, the rachis blackish, filiform, flexuous, evident and minutely appressed-pubescent beneath, the hairs distant, short, whitish, geminate or subfasciculate from a branched glandular base; segments 8–16 pairs, alternate, narrowly triangular, acute or acutish, mostly 3–5 mm. long, 2–3 mm. broad at the fully adnate, oblique or subdecurrent base, the lowermost 2 or 3 pairs gradually much reduced, long-decurrent, finally evident as a flexuous greenish wing (1 mm. broad or less); segments subentire, or often subauriculate just beyond the distal base, or the largest ones with as many as 2 relatively large crenations on both distal and proximal margins; costa capillary, immersed, terminating far from the

[1] Published by permission of the Secretary of the Smithsonian Institution.

[2] Smiths. Misc. Coll. **78**[2]: 100–111, *figs. 110–118*. 1927.

apex; vein branches few (1–4 in all), oblique, very short, terminating in conspicuous round hydathodes, the sori (1–4) also terminal, small, distant, borne near the costa, slightly impressed; sporangia glabrous. Leaf tissue delicately membranous, repand, translucent, bright green, glabrous.

Type in the U. S. National Herbarium, no. 1,182,774, collected from the densely mossy trunk of a forest tree, crest of Gossamer Peak, St. Thomas, Jamaica, altitude 800–900 meters, June 16, 1926, by William R. Maxon (no. 9280).

Among West Indian species thus far known *Polypodium Randalli* has no very near relatives. It is actually allied to *P. Alfarii* Donn. Sm., a rare and much misunderstood plant of Costa Rica and western Panama, differing from that, however, not only in its diminutive size but in its glabrous leaf tissue and glabrous sporangia, in the development of rhizome scales (*P. Alfarii* having none), and in numerous other specific characters. The specimens were not detected when collected, but were picked out, one by one, from a large thick cushion of bryophytes and Hymenophyllaceae while sorting out this material for drying.

Polypodium exornans Maxon, sp. nov.

Subgenus *Eupolypodium*. Rhizome closely branched, submulticipital, the divisions creeping, 2–4 cm. long, 4–5 mm. thick, densely imbricate-paleaceous throughout; scales firm, dark brown, lustrous, narrowly triangular-attenuate, 2.5–3.5 mm. long, 1 mm. broad at the cordate base, freely ciliate, the surfaces similarly hairy. Fronds numerous, oblique-pendent, subdistichous, close (2–5 mm. apart), 40–65 cm. long, the stipes 12–20 cm. long, 1 mm. thick, dull brown, not arcuate at apex, densely beset with pale, persistent, spreading or retrorse hairs (2–4 mm. long); blades linear, 30–50 cm. long, 3–4.5 cm. broad, abruptly acute at the slowly determinate apex (the subcaudate tip eventually 1–1.5 cm. long, lobate below), subtruncate or slightly narrowed at base, pinnatisect throughout, the rachis blackish, bearing many long stiff

oblique-spreading ferruginous hairs, these extending freely along the margins and over the upper surface of the segments, the under surfaces similarly covered with paler and somewhat shorter hairs; segments 40–60 pairs, alternate, close, oblong, 1.5–2.5 cm. long, bluntly acutish at apex, 5–6 mm. broad at middle, adnate, broadly short-decurrent (the wing triangular), rarely subdilatate at upper base, horizontal or (in larger fronds) decurved, subentire or lightly undulate, coarsely septate-glandular (chiefly at the hair-bases of the under surface); costa filiform, blackish, lightly flexuous, evident beneath nearly throughout; veins 9 or 10 pairs, simple, oblique (45 degrees), extending three-fourths the distance to the margin, terminating in minute dark punctiform hydathodes; sterile veins straight, fertile ones nearly so; sori 4–8 pairs, dorsal, 1.5 mm. broad at maturity, inframedial, the receptacle small, not spurlike; sporangia very numerous, cinnamon brown, each bearing a single griseous seta 3–5 times as long as the head of the sporangium. Leaf tissue dull green, membrano-herbaceous and semitranslucent in drying.

Type in the U. S. National Herbarium, no. 1,182,697, collected on the upper southern slope of Gossamer Peak, St. Thomas, Jamaica, altitude 750–900 meters, from tree trunk on moist forested ridge, June 14, 1926, by William R. Maxon (no. 9185).

Known to the writer from Jamaica only, but common there, particularly in the Cuna Cuna region, at the eastern end of the main Blue Mountain range (*Fredholm* 3251; *Maxon & Killip* 172; *Maxon* 8847, 9116, 9130, 9479, 10547), its most luxuriant development being in deep forest ravines near House Hill. Other specimens are as follows: Spur of John Crow Mts., opposite Mill Bank, *Maxon* 9382; deep valley of Mabess River, *Maxon* 1541, *Watt* 97; near Jumbe Spring, Portland, *Maxon & Killip* 781; Hollymount, *Maxon* 1911, 2250; Tweedside, *Maxon* 1016. The altitudinal range is from 300 to 900 meters.

The present species was called *P. asplenifolium* L. by Jenman, and was very incompletely described by him[3]

[3] Bull. Bot. Dept. Jamaica II. 4: 123. 1897.

under that name. The writer has shown,[4] however, that the name *asplenifolium* must be taken up for the widely distributed tropical American species which Jenman and most recent writers have called *P. suspensum*, the Linnaean name *suspensum* itself being of very doubtful application. From true *P. asplenifolium* L. (*P. suspensum* of authors) *P. exornans* differs constantly in many essential characters, notably in its non-geniculate, dull brown, copiously and persistently long-pilose stipes (wiry, atro-purpureous, and highly lustrous in *P. asplenifolium*); its darker, firmer, and non-ligulate rhizome scales; its oblong (rather than deltoid-oblong) segments, which are rather thin and copiously hairy on both sides (not rigid and nearly devoid of hairs beneath); and in its long solitary sporangium setae, the sporangia of *P. asplenifolium* bearing each 2 to 4 short setae which about equal the head of the sporangium in length. Incomplete specimens may be distinguished at once by the sporangia alone.

Polypodium laxifrons Liebm., sometimes recognized as a valid species, is exactly synonymous with *P. asplenifolium* L.

Dryopteris Underwoodiana Maxon, sp. nov.

Subgenus *Lastrea*. Rhizome stout, erect, arcuate, 4–10 cm. long, 1.5–2 cm. thick, densely clothed with imbricate stipe bases, freely paleaceous; scales laxly imbricate, light brown, lustrous, thin, lance-attenuate, 5–8 mm. long, deciduously short-ciliate, the surfaces obscurely pubescent at first with short whitish hairs. Fronds 6–8, cespitose, rigidly ascending, 40–65 cm. long, the stipes short (3–10 cm.), stout (2–3 mm.), dull stramineous, scaly at base, together with the rachis rather densely whitish-hirtellous; blades acutely elliptic-oblong to narrowly obovate, evenly long-acuminate at apex, rather abruptly acuminate-attenuate at base (4–7 lowermost

[4] Sci. Surv. Porto Rico 6: 411. 1926.

pairs of pinnae greatly reduced, 5–10 mm. long, successively smaller and more distant), 35–55 cm. long, 10–16 cm. broad at middle, pinnate-pinnatifid; pinnae mostly alternate (the basal ones usually opposite), numerous, subcontiguous, spreading, inserted 10–16 mm. apart, sessile, the middle ones narrowly oblong-linear, acuminate-attenuate in the outer half (the tips subcaudate), 1–1.5 cm. broad at middle, deeply pinnatifid, the costa sulcate and strigose-hispid above, unevenly pilose-hispid beneath; main segments of larger pinnae 16–20 pairs, oblique, close, oblong from a slightly broader base, 2–3 mm. broad, acutish distally in drying (the subentire margins lightly revolute), with narrow, acute, open sinuses, obliquely ciliate, the basal ones (especially the proximal) sometimes subauriculate and partially overlying the rachis; veins 6–8 pairs, oblique, strongly elevated above, evident beneath, mostly simple, the proximal basal one sometimes forked; midrib and veins freely hispid above (the interspaces hispidulous), sparsely pilose-hispidulous beneath; small basal pinnae deflexed, commonly hastate-tripartite; leaf tissue firmly chartaceo-herbaceous, translucent, dark green and lustrous above, freely resinous-glandular beneath; sori 6 or 7 pairs, medial, distant, round; indusia orbicular-reniform, thin, long-ciliate, resinous-glandular, ample but soon nearly concealed by the sporangia, the cilia protruding; sporangia numerous, glabrous.

Type in the U. S. National Herbarium, no. 1,045,385, collected in the vicinity of St. Helen's Gap, Cinchona, Jamaica, altitude 1,475 meters, on a rocky bank in thin shade, March 4, 1920, by William R. Maxon and Ellsworth P. Killip (no. 635). Besides other material from St. Helen's Gap (*Maxon & Killip* 636, 1338, 1355) the species is represented by the following specimens: Without locality data, alt. 1,500 meters, *Hart* 128; Cinchona, *Clute* 101; Moody's Gap, *Clute* 173; New Haven Gap, alt. 1,650 meters, *Maxon* 2659. The last two specimens were identified long ago by Christensen as *D. scalpturoides* var. *jamaicensis* C. Chr.; but the type collection of that variety (*Underwood* 1826, from Mount Diablo) is identical with *D. Nockiana* (Jenman) C. Chr.

Jenman, in his Synoptical List, described the present species as *Nephrodium rigidulum* Baker, which is synonymous with *D. scalpturoides* (Fée) C. Chr., a species known properly only from Cuba and Hispaniola. From this *D. Underwoodiana* differs in many characters, notably in its less coriaceous texture, its more numerous veins, its hispid midveins and veins (above), its golden resinous glands and pilose-hispid condition beneath, and especially in its medial (not submarginal) sori. The relationship with *D. Nockiana* is very much closer, but that species, as represented by a large suite of Jamaican specimens, is a plant of lower altitudes, with narrower and longer fronds, similarly glandular beneath but having the pinnæ narrower and more distant, the costæ and midribs merely puberulous beneath, and the upper side of the segments non-hispid. The presence or abundance of minute stiff hairs between the veins on the upper surface is a variable character in all these species.

WASHINGTON, D. C.

Tauranga and Karewha Island

H. B. DOBBIE

While I was on a visit to Tauranga, about 100 miles south of Auckland, Mr. Bernard Sladden kindly offered to take me in his launch to Karewha Island. We had such a rough time on leaving the harbor, bobbing about like a cork, that Mr. Sladden feared we should not be able to land, a prediction that, fortunately for me, was not fulfilled.

The little island, six miles from Tauranga, about five acres in extent and rising to a rocky peak 300 feet above the sea, with its mantle of green, looked very beautiful on a near approach. We anchored about fifty yards from the shore in smooth water, protected by a reef and some

rocky islets. A short pull in the dinghy brought us to the shore, where I had no difficulty in landing on a flat boulder. There is no beach proper, just a narrow strip of diorite boulders, ranging in size from a wheelbarrow to an omnibus, wedged tightly together—not a pebble, particle of sand or shell to be seen, if we except some mammoth limpets on the boulders.

Immediately above the rocks and often overshadowing them is a dense growth of small trees with light-green leaves that look as if they had been polished (*Coprosma Baueri*). The light-grey soil beneath is nearly bare from the passage of countless mutton birds, Ha-koa-koa, *Puffinus tenuirostris*, that inhabit the island for breeding ing purposes; indeed, it is a vast rookery, the whole island, except where the rocks protrude, being covered with their burrows. This makes walking fairly easy, though the ground sometimes gives way and you sink to the knees in one of the burrows. On one of the numerous occasions of this happening, Mr. Sladden descended on top of a mutton bird, a slim, handsome creature, nearly black, with a long beak hooked like that of an albatross. He also got the long white egg, for at this season the birds are setting. They lay but one egg a year. It was a curious sensation to walk in this solitude, where there was no sound or movement of life, and yet to know that there were thousands of noisy, active birds under your very feet.

The trees nearly all grow slanting down hill and are kept vigorous and verdant by the quantities of guano. Besides the Tau-pata (*Coprosma*), we saw a few other species of small trees—hou-para, ka-raka—and one solitary specimen of the para-para, that curious plant, a veritable "upas-tree" for the small birds. It has a sticky gum about the seeds which catches the birds' wings and holds them until the poor things die of starva-

tion. There were also several patches of Captain Cook's scurvy grass, a large herbaceous plant with white flowers, which preserved the health of his crew during their famous voyages of discovery round New Zealand, and a pale mauve Mesembryanthemum about an inch in diameter.

The only living things which I saw besides the mutton bird so unceremoniously unearthed by Mr. Sladden, were a fantail and a lizard. The "pi-waka-waka," a species of flycatcher, follows one through the bush, the Maoris aver, to catch the insects disturbed by your passage; it is a most friendly little bird, often perching on a twig within a yard, chirping and flirting its beautiful outspread tail. The tua-tara, that strange lizard which lives in good fellowship and peace in the burrows of the mutton bird, *Sphenodon punctatus*, to give it its scientific name, is the oldest living reptile, midway between a turtle and a lizard. Its nearest ancestor lived in North America in the Cretaceous Period. It is found only in New Zealand, on a few small islands. The one I saw, about fourteen inches long, crawled into a mutton bird burrow, trailing its tail in the loose earth, and many such tracks were observed about the island. It is a strange uncouth beast belonging to a bygone age.

All these objects were most interesting, but were not what I came to Karewha for. My intention was to examine *in situ* a species of fern, named *Asplenium Shuttleworthianum* by Kunze and by Dr. Hooker reduced to a variety of *A. flaccidum*. It is found in New Zealand only on a few guano islands off the east coast, growing upon the rocks and about the roots of the trees in great bunches, many of which you cannot embrace with your two arms, containing over 100 closely compacted fronds, one to two feet long by three to six inches broad, literally in thousands—one could freight a ship with their fronds.

The leaves are stout and leathery, three times divided, the stalk being half the length of the frond. Sometimes the roots of the older plants form a kind of trunk eight inches high. The fronds are never flaccid and pendent, as is usual with *Asplenium flaccidum*, but grow upright, sometimes with a slight curve toward the tip. There appear to be two varieties, one more finely cut than the other.

The only other species that I noted were some strong, vigorous plants of *Asplenium lucidum*, but they differed very little from those found on the mainland. Karewha is well worth while.

I also spent an hour or two on Tuhua, or Mayor Island, 28 miles from Tauranga, over 3,000 acres in extent, and mountainous to a height of 1274 ft. There is no running stream on the island, which is unusual for New Zealand. I found *Pteris comans* growing under the Christmas trees to a great size; I measured a frond 7 ft. 9 in. high by 4 ft. 9 in. broad—about double the usual size. I also found *Lomaria Norfolkiana* which, hitherto, has only been reported from the Three Kings and Little Barrier Islands; I have also found it on the mainland ranging in length from 2 ft. to 3 ft. 2 in. I consider it only a large form of *L. lanceolata*, as one finds every gradation from 8 inches to thirty-eight.

The Mount Mannganui is a conical rocky hill about 1,000 ft. high, standing at the end of a long sand spit separated from Tauranga by an inlet of the sea. It seemed an unpromising field for ferns, yet I found there two species that I had hunted for fifty years, *Lomaria Banksii* and *Asplenium obtusatum*. The former was growing along a crack in a low cliff just above the shelly beach, and is remarkable for the fertile fronds being much shorter than the barren ones. With regard to *Asplenium obtusatum*, I am inclined to place it as a

doubtful variety of *A. lucidum*. It is found only on rocks; the rounded obtuse pinnae grow on the same plants as those with pointed ends.

Mr. Cameron, who took me for another long journey into the Oropi bush, talked enthusiastically about being lowered over a precipice several hundred feet in height in search of some very fine specimens of *Lindsaya viridis*. The sight of a long rope under the car seat filled me with forebodings which, I am happy to say, were groundless.

The weki ponga, *Dicksonia fibrosa*, is the most plentiful tree fern on the mountains behind Tauranga. In one grove of many hundred trees nearly all had several heads, the trunks branching from one main stem. I counted fourteen in one case.

Before closing this paper I must mention a curious incident, though it has no connection with ferns. A great many lemons are grown at Tauranga, where the rich, sandy soil seems to suit them. The cows have developed a taste for the acid fruit and eat them greedily, though the tears trickle from their eyes. It is interesting to know that the crocodile is not the only four-footed animal to shed tears.

AUCKLAND, NEW ZEALAND.

Ferns of Monroe and Adjoining Counties, New York

JOSEPHINE ZOLLMAN EDSON

POLYPODIUM VULGARE L. Frequent.

This fern is quite common with us, being found at the Gulf, LeRoy, Clark's Gully, Naples and in an arbor vitae swamp in Chili. At the two former places it is found growing on limestone cliffs, but in the latter it thrives on rotting logs and stumps. Habitat: rocky woods.

PHEGOPTERIS POLYPODIOIDES Fée. Rare.

Reynold's Gulf in Livingston County and Clark's Gully, Naples in Ontario County are the only places, to my knowledge, where this fern is found in this locality. It is found, in both instances, in rocky ravines.

PHEGOPTERIS HEXAGONOPTERA (Michx.) Fée. Frequent.

This beech fern is much more common than the preceding, being found in almost any dry woods. Have found it in a wood on the Townline Road, Gates, Canadice Heights and Marsh Road, Perinton.

An aid in distinguishing this fern from *P. polypodioides* is the winged rachis of *P. hexagonoptera*.

PHEGOPTERIS DRYOPTERIS (L.) Fée. Occasional.

The oak fern has been found in marshy woods at various places in this vicinity among them; Canadice Heights and Reynold's Gulf and in Bergen Swamp in Monroe County.

ADIANTUM PEDATUM L. Common.

In practically any woods you may find this attractive fern, whose habitat is either moist or dry woods.

The two places where I have found it most abundant are a wood on the Marsh Road, Perinton and an arbor vitae swamp in Chili.

PTERIS AQUILINA L. Common.

This fern haunts the dry fields and roadsides everywhere—one of our commonest ferns.

PELLAEA ATROPURPUREA (L.) Link. Rare.

There is only one station in this vicinity for the purple cliff brake, the Gulf, LeRoy, in Genesee County. On the dry limestone cliffs it grows in inaccessible places. This summer I was interested to note a number of sporelings which promise well for the permanency of this station.

WOODWARDIA VIRGINICA (L.) Sm. Local.

This fern is found in sphagnum swamps at Spencerport, Mendon Ponds and the Ballinger Swamp, Ionia.

ASPLENIUM TRICHOMANES L. Rare.

Rosettes of the dainty Trichomanes adorn the cliff faces in Clark's Gully, Naples, Reynold's Gulf, Livingston County, and the Gulf, LeRoy. Habitat: limestone cliffs.

ASPLENIUM PLATYNEURON (L.) Oakes. Scarce.

The ebony spleenwort is not a cliff-dweller, but lives in rocky, wooded ravines, where its green pinnae gleam like emeralds against a background of leaf-mould. It has been found at Honeoye Lake and Sullivan's in Ontario County and at the Gulf, LeRoy, Genesee County.

(To be continued)

ROCHESTER, N. Y.

Recent Fern Literature

Just as we had bidden a reluctant farewell to Prof. Victorin's series of articles on the fernworts of Quebec, he returns briefly to the subject to describe a new species of *Botrychium—B. minganense*. It is very closely related to *B. Lunaria*, with which it agrees in the manner of folding of the leaf in the bud and in the point of insertion, general shape, and pinnate character of the sterile segment. It differs in the spores, which average about 1/5 larger and are more finely reticulated, in the commonly laciniate pinnae of the sterile segment in well-developed plants and in being "generally variable in the same colony." The last is an unusual character to employ in separating species (though, as taxonomists know to their cost, it may be real enough), but Prof. Victorin points out "there is all the difference in the world between the geographic variability of a wide-ranging species and the purely genetic and, moreover, apparently irregular variability which is characteristic of certain Botrychia." When such variability has been recognized as characteristic (as by Prof. Fernald in his discussion of *Polypodium vulgare* in *Rhodora* 24: 135) it has usually been found to be associated with species of presumably recent origin; *B. minganense*, however, is believed by Prof. Victorin to belong to the ancient flora of the unglaciated regions of northern North America. In spite of its name, it is by no means regarded as confined to the Mingan Islands; specimens from several localities about the Gulf of St. Lawrence, from the west shore of Hudson's Bay, and from the Cordillera of western North America are referred to it.[1]

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[1] Victorin, Fr. Marie-. Sur un Botrychium nouveau de la flore Américaine et ses rapports avec le B. Lunaria et le B. simplex. Trans. Roy. Soc. Canada, ser. 3, xxi (sect. V), 319–340. 1927. 6 figs., 3 pls.

Prof. M. L. Fernald has published a study of the American form of the holly fern, *Polystichum Braunii.* Most species common to Europe and America are circumboreal in range; but *P. Braunii* reaches the Arctic in neither continent, in America being a plant of the Canadian forest region. It is thus completely isolated from the European plant and, from geological evidence, doubtless has been for a very long time. In numerous similar cases, differences have developed which set the plants concerned apart as good species. That is not the case here; but Prof. Fernald finds some differences, in texture, in the scales of the stipe-base and of the rachis. He remarks that the slightness of these differences illustrates the conservatism of the ferns, but that they are "sufficient to make it clarifying to distinguish the eastern American plant . . . as a geographic variety." He calls it *P. Braunii,* var. *Purshii,* in honor of Frederick Pursh who first detected it in the Green Mountains of Vermont in 1809.[2]

Prof. Clute announces a re-issue of his "Fern Allies of North America," well known to fern-lovers. A brief introduction has been added, the eight colored plates of the first edition are omitted and the remaining illustrations differently arranged. Otherwise the new issue is exactly like the old. Five hundred copies are to be printed and the plates then destroyed. The price is four dollars, from Willard N. Clute & Co., Joliet, Illinois.

SCOLOPENDRIUM NOTES—We found on Nov. 23, 1924, that the Solvay Company had done all preliminary work and were ready to quarry the limestone at the Scolopendrium Station, East Green Lake, Jamesville,

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[2] Fernald, M. L. The eastern American variety of Polystichum Braunii. Rhodora **30**: 28–30, pl. 150. 1928.

but when the officers of the company learned of the rare fern station that would be destroyed they very kindly informed us that they would divert their operations and give us ample opportunity to remove the plants.

Mild weather, Dec. 7, 1924, permitted us to take up 350 mature and 50 to 100 small Scolopendriums, and plant them at East Green Lake on the Clark Reservation; this place was a station for the ferns, where they were once plentiful, but had become almost entirely exterminated. We will try and make a count of this planting in the spring. This place seemed at the time the best available, but it is exposed to flood water coming over the rock crest, in exceptional floods. Jewel weed has taken possession of the muck soil and shades the ferns so completely as to kill them, and the Clark Reservation is now a Recreation Park under the N. Y. State Park Commission. There were a number of ferns left at East Green Lake and on July 7, 1925, we removed 200; on Nov. 8 we removed 100; and on Nov. 1, 1925, we removed 125 plants from a dry pond S. E. from White Lake. These 425 we planted in a deep long dry pond on the Clark Reservation. This seems to be an ideal home, it is full of trees, shrubs, fallen timber and rocks and is not an inviting place for recreation, nor is it infested with Jewel weed. It had a small number of plants as a natural station. On Jan. 15, 1928, we counted 428 living ferns in this place, besides many small ones.

The other stations in the Jamesville woods seem thriving, but they are on private property where the beautiful hickory and iron wood trees have been cut for fire wood over a large space extending almost to one of the dry pond stations.

At Split Rock—the supposed original station found by Pursh in 1807—we found, Jan. 14, 1928, ten plants.

Chittenango Falls is also a Reservation State Park and has been improved by a foot bridge across the creek to a trail leading to the Scolopendrium station.

At Perryville the Scolopendriums are doing well—their fronds seem narrow and longer than at the other stations.

We counted, Dec. 5, 1925, 85 plants at Hanging Valley Gorge, which is now a Boy Scout Camp.—N. M. SADLER, J. B. TODD, *Syracuse, N. Y.*

FERNS AT DRIPPING SPRING, OKLAHOMA.—On May 3, 1925, Dr. John K. Small and I travelled by automobile from Tulsa, Oklahoma, to Fayetteville, Arkansas, and shortly before reaching the boundary between the two states passed a fenced-in area, into which tourists were invited to come, on payment of a small admission fee, to see the Dripping Spring. Expecting that some notable native plants might be preserved within the enclosure, we went in and spent an hour or so investigating the ravine into which the spring drips. No flowering plants of particular interest were in evidence, but eleven species of ferns were observed, including *Asplenium bradleyi* D. C. Eaton, new to the State. One of the two plants of the latter species seen was collected and deposited in the U. S. National Herbarium, but the recent appearance of an article on Oklahoma Pteridophytes by Mr. Greene[1] reminds me that it may be desirable to publish a note on the occurence also.

As is frequent in the Ozarks, the surface rock at this point is chert, which gives rise to more or less acid soils, while the spring emerges along an underlying limestone stratum, the water and the soils at lower levels being correspondingly somewhat alkaline. At first sight there

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[1] AMER. FERN JOURNAL 17: 125, 1927.

seemed to be little relation of the ferns to the soils, as all the species occurred to some extent at or near the ravine-floor; but on making tests it was found that many large masses of rock which had tumbled into the ravine had carried soils of different acidities, and the ferns each supported, down with them. This point deserves emphasis, because if actual tests had not been made, all the species would have been inferred to be growing in calcareous soils, and one more erroneous statement that *Asplenium bradleyi* occurs on limestone have been added to the several which have appeared in the literature in the past.

The species observed are listed here in the order of decreasing acidity exhibited by their soils at this locality:

Cheilanthes lanosa (Michx.) Watt. Abundant on chert ledges, occasional on fallen blocks; soil reaction subacid.

Asplenium bradleyi D. C. Eaton. Only two small plants were seen, on a large chert mass in front of the spring. The soil reaction was barely subacid, some neutralization of acidity by spray having evidently occurred. This no doubt also grows on the inaccessible chert ledges high above, and the soil may well be more acid there, the species showing mediacid preferences in other regions.

Asplenium platyneuron (L.) Oakes. Commonest on lower part of chert stratum, where the soil is high minimacid.

Cystopteris fragilis (L.) Bernh. Under overhanging chert ledges, back of spring; high minimacid.

Polystichum acrostichoides (Michx.) Schott. In woodland humus in vicinity; soil minimacid.

Asplenium trichomanes L. and *A. resiliens* Kunze. Chiefly on upper limestone outcrops, where the soil ranges from low minimacid to neutral.

Dryopteris marginalis (L.) Gray. In a variety of situations, but most common on talus where the soil is neutral or barely minimacid.

Camptosorus rhizophyllus (L.) Link and *Cystopteris bulbifera* (L.) Bernh. On the lower parts of the limestone strata, where the reaction ranges from neutral to minimalkaline.

Adiantum capillus-veneris L. In the minimalkaline spring water, forming a beautiful green curtain.

The impression obtained after taking the observations here placed on record was that, at this locality, the soil reaction is at least equal in importance to the moisture content in determining the locations of the individual species.—EDGAR T. WHERRY, *Washington, D. C.*

American Fern Society

Dr. Edwin Holmes Munger, a member of the Society since 1914, died at Hartford, Conn., Feb. 1, 1928, aged 58. He was born at Essex, Conn., and graduated from the Philadelphia Dental College in 1892. After practising his profession in other Connecticut towns, he settled in Hartford in 1900. There he built up a practice which kept him busily occupied during working hours and often into the evening; but he found time for many avocations. He was fond of mountain-climbing; his vacations were usually spent among the great hills, and though he never went far afield, there were none of the higher peaks of his own region, New England and the Adirondacks, which he had not ascended. He had a wide and keen interest in natural history. There was always a Wardian case of native ferns growing in his office and opposite it a case of clay-stones. He knew the birds uncommonly well, and minerals even better; he gathered a noteworthy collection of the latter, mostly

from New England. He was active in the Congregational church. But the work which probably lay closest to his heart was that with the Boy Scouts. For this, in the thirteen years he was scout-master, he showed unusual capacity and corresponding accomplishment; his troop always ranked high and nothing gave him greater pleasure than the success of his boys in any worthy endeavor. To help them toward such success he would himself have chosen as the highest achievement of an exceptionally useful life.

Report of Secretary for 1927

The Secretary begs to report that during the year 1927 we had an unusual number of new enrollments. Thirty-three (33) new names were added to the list. Four died —Sidney Harris, Prof. J. D. Kemp, Miss Annie Lorenz, and Carl Purdy. Nine resigned and six were dropped under the rule of non-payment of dues. This leaves a net gain of fifteen, making a total enrolment of 344 at the end of the year. We gain slowly but steadily.

It is greatly to be hoped that we may have some sort of meeting in New York during the Christmas holidays this year, on the occasion of the meeting of the American Association for the Advancement of Science.

C. S. LEWIS, *Secretary*

Report of the Treasurer for 1927

GENERAL FUND

RECEIVED

CASH ON HAND, JAN. 1			$ 702.78
Membership dues:	1924	$ 1.50	
	1925	5.25	
	1926	18.00	
	1927	349.27	
	1928	38.11	
	1929	2.70	
			$414.83

Subscriptions to Journal		68.22
Illustrating Fund, Gifts		2.50
Emergency Fund (sale of Back Nos.)		60.34
Gift for Journal expenses		5.00
Refund on Journal Insurance		3.60
Advertising		4.00
Reprints		22.61
Insert in Journal No. 4		8.50
Treas. expenses charged to 1928–29		15.84
Interest		25.00
		630.44
TOTAL RECEIPTS		$1,333.22

PAID OUT

Treasurer's expenses, 1927		$ 20.00
" " 1928–29		15.84
Secretary's expenses:		
Membership forms	$ 3.00	
Election expenses	10.37	
Postage	1.50	
		14.87
Reprints (later repaid)		22.61
Insert in Journal No. 4 (repaid)		8.50
Journal Expenses:		
Printing 4 Nos., including 6 pt. composition, extra pages, etc.	336.35	
Illustrations	29.84	
Addressing & Mailing	16.87	
Envelopes & Stencils	13.26	
Express to Brooklyn	4.70	
		$401.02
	$482.84	$ 482.84
BALANCE ON HAND		$ 850.38

This balance is made up as follows:

EMERGENCY FUND

On hand January 1	$ 54.27	
Received	60.34	
BALANCE FORWARD		$ 114.61

ILLUSTRATING FUND

On hand January 1	43.34	
Received	2.50	
BALANCE FORWARD		45.84
SPECIAL GIFT TO JOURNAL		5.00
Special order holding for cataloging herbarium		25.00
BALANCE IN GENERAL FUND		659.93
		$ 850.38

SPECIAL RESERVE FUND

On hand January 1	$ 755.05	
Interest received	41.40	
BALANCE ON HAND		$ 796.45

Respectfully submitted,

JAY G. UNDERWOOD, *Treasurer.*

Pressure on our space in the preceding number prevented our acknowledging Mrs. Chisholm's gift of the illustration accompanying her article in it. This we very much regret; but our gratitude is none the less lively because the expression of it has had to be deferred.

Mr. W. A. Davis, 104 Yale Station, New Haven, Conn., would very much appreciate any positive information concerning the occurrence of *Asplenium pinnatifidum* in any part of Logan County, Ohio (from which it has been reported (L. S. Hopkins, Fern Flora of Ohio, Fern Bulletin 15: 1. 1907), or the geologically very exact locations for stations of this fern at Blairstown, N. J., or the vicinity of Youngstown, Ohio.

New Members:—

Beals, Mrs. A. Tennyson, 5833 85th St., Elmhurst, N. J.

Buffington, Charles S., 963 East 6th St., Inglewood, California.

Carlisle, Morten, 71 East Hollister St., Cincinnati, Ohio.

Demaree, Delzie, Dept. of Botany, University of Arkansas, Fayetteville, Arkansas.
Freedley, Miss Anna B., 15 West 51st St., New York City.
Macy, Perry D., Springbrook, Oregon.
Mosbaek, Ludvig, Ferndale Nursery, Askov, Minn.
Smith, Mrs. Cora Roe, The Pines, Branchville, N. J.

Changes of address:—

Choate, Miss Alice D., Lesone Hotel, 5002 Waterman Ave., St. Louis, Mo.
Child, Mrs. H. W., 186 Commonwealth Ave., Boston, Mass.
Finegan, Mrs. Thomas C., 26 Strathallan Park, Rochester, N. Y.
Lewis, Rev. C. S., 345 Hamilton Ave., Trenton, N. J.
Lombard, Robert H., Box 293, Ashburnham, Mass.
Standley, Paul C., Field Museum of Natural History, Chicago, Ill.

It is with much pleasure that we realize, with this number, the hope expressed in our annual report of issuing, as a supplement to the Journal, a revised reprint of Dr. C. E. Waters's "Key to the Ferns of the Northeastern States, based on the Stipes." That we are able to do so, is due largely to Dr. Waters's kindness; he has not only given the time needed for recasting of details of the key, but has contributed generously toward the cost of printing.

There is only one illustration in this number, but we shall make up for that next time, when we print Mr. Ransier's account of some of his adventures, with reproductions of his photographs along the way.

By a regrettable error, the birthplace of Miss Annie Lorenz was given, in this JOURNAL, vol. 17, p. 141, as Hartford, Conn. It should have been Brooklyn, N. Y.

Through the kindness of Dr. Will S. Monroe and the courtesy of the Torrey Botanical Club, members of the

Fern Society are invited to join that organization in a meeting at Couching Lion Farm, North Duxbury, Vermont, Sept. 1–3, 1928. The Society has already held one meeting there; members should not need to be reminded of the attractions of the region and of Dr. Monroe's hospitality. It is hoped that a good number will be able to attend; those intending to do so should notify Mr. A. T. Beals, 2929 Broadway, New York City, not later than August 15th. He will give detailed information as to arrangements.

Dr. Everett G. Logue, First National Bank Building, Williamsport, Pennsylvania, requests that members who can will send him fresh fertile fronds of any freak ferns they may have growing in their yards or know of in the wild. He wishes to make experiments in raising such forms from spores.

An Analytical Key For the Ferns of the Northeastern States, Based on the Stipes

By C. E. WATERS

[Supplement to the American Fern Journal, Volume 18, Number 2, 1928.]

ANALYTICAL KEY

In 1895 an analytical key based on the characters of the stipes was published for the 35 species of ferns then known in the Baltimore, Md., region. It appeared in the Johns Hopkins University Circulars. Seven years later a much enlarged key was published in the same place. It took account of all but a few of the species in the sixth edition of Gray's *Manual*. The species omitted were among the rarer ones, so that the key could serve the every day needs of the beginner; it met with favor among those who tried it. The decision to publish it once again led to its becoming the nucleus around which a book grew.[1]

The present edition of the key is still incomplete, because there has been no opportunity to study and to include the species formerly omitted and those that have been found within our area in the intervening years. The text has been rearranged in places, and the nomenclature has been revised, chiefly by W. R. Maxon. To facilitate reference, certain names not adopted here, but in use in current manuals or in recent studies, are added in parentheses.

How to Use the Key

It is necessary to have only a sharp knife and a good pocket-lens in order to determine the ferns. The fern to be studied should be carefully picked so as to secure the entire stipe, and it should not be allowed to wither, because grooves or ridges that do not properly belong to it may result from the shrinkage of the tissues.

[1] Ferns. Henry Holt & Co., New York. 1903.

When the ferns are small, it is best to select as large a one as possible, for it is not only easier to study the larger stems, but the ferns may happen to be young plants of a large species. The nearer they are to the average mature size, the more certain is their identification. However, in working out the key the variations due to size alone were taken into account.

In nearly every fern the extreme lower part of the stipe is different in size, shape or color from the upper part. The "typical" cross-section is made by cutting the stipe squarely across just above this basal part. The easiest way to make the cut is to lay the stem on a board and to slice it with a quick drawing stroke. The cut ends of the fibrovascular bundles are seen as one or more dots or lines, usually lighter in color than the surrounding tissues. When a bundle is said to be round, oval or flat, it means, of course, that the dot is of this shape.

Except when a species never has more than one fibrovascular bundle in the stalk, it is found that fronds from small plants have fewer bundles than those from plants of average size. This has made it necessary to insert numerous cross-references in the key.

The grooves and ridges so often mentioned are in many cases difficult to see. In doubtful cases the stalk should be held horizontally and slowly turned between the fingers, while facing a bright light.

The following definitions are adhered to in the key. The *stipe* is that portion of the stalk which is below the leafy part of the frond. The *rachis* is the continuation of the stipe through the leafy part, unless this is entire or nearly so, in which case the term *midrib* is used. The stipe and rachis together form the *stalk*. The *front* of the stalk is on the same side as the upper surface of the frond. The opposite side is the *back*. *Above* and *below* mean near the upper and lower end, respectively, of the stipe, rachis or stalk.

A. ONE BUNDLE

I. Bundle Decidedly Curved.

* Bundle more or less rolled up or folded at the ends.

1.—*Osmunda cinnamomea* and var. *glandulosa.* Stalk green, often reddish below in large specimens. Rachis and upper part of stipe narrowly 2-winged or ridged. Small stipes often have traces of grooves in front. Bipinnatifid. Pinnae deciduous, with a persistent tuft of wool at the base of each. The variety has the stalk and pinnae more or less glandular-pubescent. 3–5 feet. Swamps, etc.

2.—*Osmunda claytoniana.* Much like No. 1, but the entire stipe is 2-ridged. Large stalks have traces of grooves in front. Bipinnatifid. Pinnae deciduous, without wool tufts. 2–4 feet. Low grounds.

3.—*Osmunda regalis.* Stalks dark, rather hard. Rachis 2-winged above. Bipinnate. No wool at base of pinnae. 2–5 feet. Swamps, etc.

4.—*Adiantum pedatum.* Stalks very dark brown, polished, wiry; slightly grooved in front, below. Fronds dichotomously forked, or ternate in small specimens. 9–15 inches. Rich woods.

** Bundle not rolled up at the ends.

5.—*Botrychium silaifolium.* Stalks very soft, reddish. Divisions of rachis and upper part of stipe grooved in front. Bundle almost or quite curved into a ring below; above, dividing into 2–4. Ternate; bipinnate to tripinnatifid. 4–16 inches. Wet thickets, etc. *B. dissectum* differs only in the cutting of the segments. (*B. ternatum* var. *intermedium.*)

6.—*Cryptogramma acrostichoides.* Stalk deeply grooved in front. Stipe brown, slender, laterally grooved; grooves less distinct below. In small stipes the bundle is a mere dot, and at times it is barely curved. Rachis green, sometimes brownish below. Small, very delicate. Bi-tripinnatifid. Shaded rocks.

7.—*Pellaea atropurpurea.* Stalk very dark brown, wiry, brittle; shining but roughish, and having light brown or whitish pubescence; no grooves or ridges. 1–2-pinnate, coriaceous. 6–18 inches. Rocks (usually calcareous).

8.—*Dennstaedtia punctilobula.* Stalk green or yellowish, except towards the brown base; glandular-pubescent throughout; grooved in front to base, and on sides nearly to

base; shining but roughened by minute projections. Tripinnatifid. 2–3 feet.

Small specimens of Nos. 28 to 39 may fall under this section.

II. Bundle V- or X-Shaped.

Small specimens of Nos. 13 to 25, 40, or sections taken too far above the base may fall under this heading.

III. Bundle Oval or Round.

9.—*Asplenium trichomanes.* Stalk very dark brown, polished. Rachis and nearly the entire stipe ridged on the sides, flattened in front. Pinnate, with roundish-oblong or oval, deciduous pinnae. 3–8 inches. Rocks.

10.—*Asplenium viride.* Stalk reddish brown at base, green above; somewhat flattened in front, below; above, deeply grooved. Stipe somewhat flattened laterally, and with traces of grooves that become more marked in the rachis. Pinnate, with roundish-ovate or ovate-rhomboid pinnae. 2–6 inches. Rocks.

11.—*Schizaea pusilla.* Stalk very slender, green (brownish when old), grooved in front (except in very small specimens) to the brown base, where it is more slender and flattened. Two very slight grooves at the back are marked by two dotted lines. 3–5 inches, the sterile fronds much smaller and linear. Pine barrens of New Jersey.

12.—*Lygodium palmatum.* Stalk light brown or yellowish, except at base; slender, twining, slightly flattened in front. The short alternate branches 2-forked, each fork with a round-cordate, palmately cleft pinnule (4–7-lobed). 1–3 feet. Moist thickets.

See also Nos. 6, 41, 42.

B. TWO BUNDLES

I. Bundles Nearly Joined in a Ring.

See Nos. 5, 46 to 50.

II. Bundles Round or Oval at Extreme Base, soon Flattening and Approximating to Form a V or X.

There can be little doubt that *Asplenium gravesii*, *A. stotleri* and *A. trudelli* belong here.

13.—*Asplenium pinnatifidum.* Lower half or two-thirds of stipe brown and shining, green above. Rachis and upper part of stipe broadly winged. Stipe flattened in front, below; higher up, with a broad groove; flattened and with

traces of grooves on sides. Pinnatifid (or pinnate below), with a slender prolongation. Veins rarely areolate. 3–6 inches. Rocks.

14.—*Asplenium ruta-muraria.* Stalk green, except at extreme base; deeply grooved in front to extreme base, with slight lateral grooves (or none in very small specimens). Texture almost coriaceous, bi-tripinnate at base. 2–5 inches. Rocks.

15.—*Asplenium montanum.* Stipe brown at base, green above. Rachis and upper two-thirds of stipe flat, with two parallel grooves in front. Pinnate, with deeply cleft pinnae; coriaceous. 2–6 inches. Rocks.

16.—*Asplenium bradleyi.* Stipe and lower part of rachis brown. Stalk grooved in front, except towards the flattened base, with a slight ridge down the center of the groove. Bipinnatifid. 4–9 inches. Rocks.

17.—*Asplenium resiliens.* Stalk black, flattened in front, below. Stipe very short, with two ridges that run into the pale brown ridges, or narrow wings, of the rachis. Pinnate, with auricled, oblong, thickish pinnae. 4–10 inches. Rocky soil. (*A. parvulum.*)

18.—*Asplenium platyneuron.* Stalk dark brown, polished. Stipe very short, not flattened, grooved or ridged. Rachis grooved in front, and with two lateral ridges (except near the base) from which the pinnae spring. Pinnate, with oblong or oblong-linear pinnae. 8–20 inches.

19.—*Asplenium ebenoides.* Stipe and lower part of rachis dark brown, polished. The green wings of the rachis run into two lateral ridges in the upper part of the stipe, which thus appears 2-grooved in front. Pinnatifid (or pinnate below), usually with a long, slender prolongation. Veins often areolate above. 4–9 inches. Rocks.

20.—*Camptosorus rhizophyllus.* Stipe brown at base, green above; flattened on three sides, slightly grooved laterally, and 2-grooved in front, above. Veins areolate. 4–12 inches. Rocks.

21.—*Cheilanthes lanosa.* Stalk brown, shining, but thickly clothed with 1–6-celled hairs, which appear jointed under a lens; articulated to the rhizome; not grooved or ridged. Two bundles rarely seen. Tripinnatifid; clothed with jointed hairs. 6–15 inches. Rocks.

22.—*Woodsia glabella.* Stalk green or yellowish, except at extreme base; smooth, grooved in front nearly to base.

Stipe articulated above base, with a few pale scales below the joint, smooth above. Pinnate, with lobed pinnae. 2–5 inches. Rocks.

23.—*Woodsia alpina.* Stalk more or less hairy; black at base, brown, shading to yellowish above. Stipe articulated above base. Pinnate, with pinnatifid pinnae. 2–6 inches. Rocks.

24.—*Woodsia ilvensis.* Stalk flattened and grooved in front to or below the joint above the base; brown below, shading to green above. Stipe and under side of rachis scaly. Pinnate, with pinnatifid, chaffy pinnae. 2–8 inches. Rocks.

25.—*Woodsia obtusa.* Stalk brown at base, green or yellowish above, with pale scales and glandular pubescence; usually marked with two green lines. Stipe not articulated. Rachis and upper part of stipe grooved in front, and often with traces of lateral grooves. Nearly bipinnate. 6–15 inches. Rocky banks and cliffs.

III. Bundles Roundish, Not Soon Uniting into a V or X.

26.—*Dryopteris linnaeana.* Stipe slender, translucent, smooth except at dark brown base; slightly flattened below, grooved in front, above. Black tissue surrounding the bundles is very evident. Ternate rachis deeply grooved in front. Ternate, with 1–2-pinnate divisions. 3–8 inches. Rich woods. (*D. Dryopteris*; *Phegopteris Dryopteris.*)

27.—*Cystopteris fragilis.* Stalk slender, weak, brown below, green above, smooth; with lateral grooves (often absent from small specimens); grooved in front, except at the flattened base. Very variable. 8–15 inches. Cliffs and rocky woods. (***Filix*** *f.*)

28.—*Woodwardia areolata.* Stipe dark brown and tapering at base, green or stramineous above, with scattering, brown scales; flattened (and rarely with traces of grooves) in front; laterally ridged. Pinnatifid; scaly beneath along midribs; veins areolate. 10–18 inches. Wet woods near coast. (*Lorinseria a.*)

See also Nos. 41 and 42 (small specimens).

IV. Bundles Oval or Flat (curved in No. 40).

* Bundle usually 1½ to 2½ times as long as broad.[2]

29.—*Dryopteris noveboracensis.* Stalk grooved in front, slender, pubescent. Rachis flattened on sides, with slight grooves.

[2] Written 1½ x 1 and 2½ x 1 in the descriptions.

Stipe less flattened and with traces of grooves. Bundles about 2 x 1, bridged.[3] Pinnate, with pubescent, pinnatifid pinnae, the lower pairs much reduced. Veins simple. **12–24 inches. Moist woods, etc.**

30.—*Dryopteris simulata.* Stalk weak, pubescent. Bundles 2 x 1, bridged. Rachis distinctly 3-grooved. Stipe similarly grooved above; the lateral grooves extend to the dark base; lower half, or less, of stipe flattened and with traces of two grooves in front. Pinnate, with pubescent, pinnatifid pinnae, the lowest scarcely reduced. Veins simple. 8–20 inches. Wet thickets in dense shade.

31.—*Dryopteris thelypteris.* Stalk 3-grooved, except at base, where it is flattened on three sides; pubescent. Bundles not bridged, $1\frac{1}{3}$ x 1. Pinnate, with nearly smooth, pinnatifid pinnae, the lowest scarcely reduced. Veins forked. **12–24 inches. Swampy places.**

32.—*Cystopteris bulbifera.* Stalk weak, translucent, pale green (often pinkish) shading to brown below. Stipe flat in front, below. Bundles about 2 x 1, not bridged. Rachis and upper part of stipe grooved in front, flattened and with traces of grooves on sides. Bi-tripinnate. Rachis and midribs of pinnae often bulbiferous beneath. 12–24 inches. Damp ravines. (***Filix b.***)

33.—*Dryopteris hexagonoptera.* Stipe slightly flattened in front, and with a light green line on each side (except in forms which approach No. 34 in general appearance); often with traces of front and lateral grooves. Bundles uniting rather soon, bridged. Frond triangular, about as broad as long; bipinnatifid, pubescent; often with scales along the midrib beneath. 7–20 inches. Open woods. (***Phegopteris h.***)

34.—*Dryopteris phegopteris.* Stipe usually rather dark above; pubescent, flattened in front, and usually grooved. Frond triangular, longer than broad, bipinnatifid, pubescent, with scales along the midrib, beneath. 8–15 inches. Damp woods. (*Phegopteris polypodioides.*)

** Bundle usually more than $2\frac{1}{2}$ times as long as broad.

35.—*Athyrium angustifolium.* Stalk green, with brown pubescence; black at extreme base, where there is a dense sheath of hairs; deeply grooved in front. Stipe grooved

[3] In section IV some of the bundles coalesce at a distance above the base and form a curved bundle. In others they become united by a straight connective which joins their ends at the back. For convenience these will be called "bridged" bundles.

in front, except at the 2-ridged base. Rachis flattened laterally above, grooved below; narrowly 2-winged near top. Pinnate, with thin, linear-lanceolate pinnae. 1–3 feet. Rich woods. (*A. pycnocarpon*).

36.—*Athyrium filix-foemina.* Stalk green or reddish, smoothish; 3-grooved nearly to the base, where there are a few tooth-like projections on the lateral ridges. Bundles bridged. Bipinnate, with more or less incised pinnules. Very variable. 1–3 feet. Moist woods. (*A. angustum* and *A. asplenioides*).

37.—*Athyrium acrostichoides.* Stalk green, pubescent; grooved in front and slightly on the sides, except the lower half of the stipe. Stipe with tooth-like projections on the lateral ridges at the extreme base. Bundles bridged. Bipinnatifid. 1½–4 feet. Rich, moist woods. (*A. thelypteroides*).

38.—*Onoclea sensibilis.* Stalk yellowish (often pinkish at base), smooth; triangular in large specimens, with traces of grooves in front and on the sides, above; 2-ridged below on sides; above, with two light lines that run into the broad wings of the rachis. Broadly triangular, deeply pinnatifid. Veins areolate. 1–2½ feet. Wet thickets, etc.

39.—*Pteretis nodulosa.* Stalk dark green, deeply grooved in front, much flattened and with traces of grooves on the sides. Rachis very narrowly winged on each side of the front groove, so that it apparently has three grooves in front and two on each side. Some stipes have tooth-like projections at the rhombic base. Bundles bridged. Bipinnatifid, with the lower pinnae much reduced. Alluvial soil. (*Onoclea* and *Matteuccia Struthiopteris.*)

40.—*Phyllitis scolopendrium.* Stipe scaly, somewhat flattened on three sides and 2-ridged above; traces of grooves in front, near the middle. Bundles very much curved, and finally forming an X. Simple, oblong-lanceolate with a cordate base; scaly along midrib, beneath. 5–18 inches. Rich woods, very local. (*Scolopendrium vulgare*).

C. THREE BUNDLES

I. Bundles Curved, Arranged in a Ring.

See Nos. 5, 46–50.

II. Bundles Round or Oval.

41.—*Polypodium polypodioides.* Stalk and under side of pinnae covered with peltate scales with dark centers, and ovate,

laciniate scales (especially on front of the stipe). Stipe articulated to the rhizome; 2-ridged in front. Bundles three at extreme base, soon becoming two, and then one. Pinnatifid. 2–6 inches. Rocks and trees.

42.—*Polypodium vulgare.* Stalk green, smooth or nearly so; 2-ridged so that the front often seems 2-grooved; articulated to rhizome. Bundles soon uniting, as in No. 41. Pinnate or nearly so, smooth. 4–10 inches. Rocks. (*P. virginianum*).

43.—*Dryopteris fragrans.* Stalk yellowish green, scaly and glandular-pubescent. Rachis and upper part of stipe grooved in front. Bundle at back of stipe slightly smaller than the other two. Bipinnatifid, glandular. 4–12 inches. Rocks. Large specimens may fall under E.

44.—*Ophioglossum vulgatum.* Stipe green, soft and spongy, grooved in front above. Bundles 3–6, obscure, arranged around the irregular spongy center. Simple, ovate to elliptic. Veins areolate. 2–10 inches. Bogs and pastures; towards the South in damp woods.

Small specimens of all of the species properly belonging under E may occur here.

D. FOUR BUNDLES

I. Bundles Round or Oval.

45.—*Polystichum braunii.* Stalk densely clothed with large scales and hairs. Stipe very short, flat in front; marked with curved scars when the hairs are rubbed off; above, with traces of lateral grooves that run into two ridges below. Rachis grooved in front, flat on sides. Bundles four near base, often five above. Bipinnate, with chaffy pinnae, the lower ones reduced. 1–2 feet. Deep woods.

Small specimens belonging properly under E may occur here. See also No. 44.

II. Bundles Curved and Arranged in a Ring.

* Bud completely enclosed in base of stipe.

46.—*Botrychium angustisegmentum.* Stalk soft, whitish below, shading to pinkish (or brownish) and then green, above; spongy. Two lateral ridges and a slight groove extend a short distance below the base of the sterile segment. Two bundles at base, two to six (usually four) a short distance above. Lamina bent over recurved fertile segment in bud (G. E. Davenport). Fleshy; triangular,

ternately bipinnatifid; midvein continuous, lobes acute. 3–10 inches. Woods.

47.—*Botrychium ramosum.* Stalk and bundles as in No. 46. Apices of lamina and fertile segment turned downward in bud (Davenport). Lamina fleshy, ovate or triangular, pinnate to bipinnatifid. Lobes obtuse; midveins dissipated by branching. 3–10 inches. Woods. (*B. neglectum*).

48.—*Botrychium simplex.* Probably belongs here. Apices of both segments erect in the bud (Davenport). Sterile segment near the base of the stem; ovate, obovate, oblong, entire, lobed or pinnatifid. 2–5 inches. Woods.

49.—*Botrychium lunaria.* Probably belongs here. Apex of lamina bent over the straight fertile segment in the bud (Davenport). Lamina very fleshy, pinnate, with lunate or fan-shaped, crenate, incised, or nearly entire divisions. 4–10 inches. Pastures.

** Bud cavity at base of stipe open at one side.

50.—*Botrychium virginianum.* Stalk fleshy, pinkish. Bundles as in No. 46. Bud pilose. Divisions of rachis with wings that run into two ridges on the stipe just below the lamina. Ternate, with primary divisions 1–2-pinnate, and then 1–2-pinnatifid. 6–24 inches. Rich woods.

See also No. 5.

E. FIVE BUNDLES

I. Middle Bundle No Larger Than the Two Adjacent Ones.

See Nos. 43–45.

51.—*Polystichum acrostichoides.* Stalk brown at base, green above; more or less chaffy. Lower part of stipe slightly flattened in front and with slight ridges (or only light lines) on sides. Rachis and upper part of stipe slightly grooved in front; sometimes with traces of lateral grooves in large specimens. Pinnate, with thickish, auricled pinnae, the lowest little reduced. 1–2½ feet. Rich woods.

52.—*Polystichum lonchitis.* Probably belongs here. Very short-stalked. Pinnate, with rigid, auricled pinnae, the lowest much reduced and short-triangular. 9–24 inches. Woods far northward.

II. Middle Bundle Larger Than the Adjacent Ones.

53.—*Dryopteris spinulosa.* Stalk with scattered scales; 3-grooved to base, where it is slightly ridged on the sides. Bipin-

nate to tri-pinnatifid; ovate-lanceolate, or ovate to triangular-ovate. 1–2½ feet. Damp woods, etc. The varieties (?) *intermedia* and *dilatata* (*americana*) are perforce included here.

54.—*Dryopteris Boottii.* Stalk with scattered scales; grooved in front, and slightly on sides nearly to base. Extreme base ridged on sides and grooved in front. Bipinnate to tripinnatifid, elongated lanceolate, narrowed at base. 1–2½ feet. Wet thickets. Intermediate between Nos. 53 and 55.

55.—*Dryopteris cristata.* Stalk with scattered scales; 3-grooved nearly to base, where it is ridged on the sides. The front groove becomes obscure towards the base. Linear-oblong or lanceolate, bipinnatifid; texture thick. 1–3 feet. Wet thickets.

56.—*Dryopteris cristata* × *marginalis.* Grooves, etc., as in No. 55. Rootstock with crown central as in No. 57 (not growing beyond the fronds as in No. 55). Upper two-thirds of frond like No. 57, being broader, and having the pinnae and apex more acuminate. Bipinnatifid. 1–2½ feet. Wet woods.

57.—*Dryopteris marginalis.* Stalk densely scaly below; grooved in front to base, and on the sides. The lateral grooves run into two slight ridges at the extreme base. Bipinnate, coriaceous. Ovate-oblong, with lanceolate pinnae. Pinnules entire or crenate, oblong. 1–3 feet. Rocky woods.

Small specimens of Nos. 58 and 59 may occur here. See also Nos. 44 and 46 to 50.

F. MORE THAN FIVE BUNDLES

I. Bundles Regularly Arranged.

58.—*Dryopteris goldiana.* Stalk with linear scales, and very large, dark brown, lanceolate ones with paler margins. Rachis and upper part of stipe grooved in front, and with two light green lateral lines that run into slight ridges at the base. Bundles usually seven, roundish. Bipinnatifid. Pinnae broadest at the middle. 2–4 feet. Rich woods.

59.—*Woodwardia virginica.* Stalk grooved in front to base, and with two lateral lines running nearly to base. Stipe and lower part of rachis brown. Central tissue of lower part of stipe usually dark brown and spongy. Rachis with a

slight ridge below the base of each pinna; 5-grooved above; below, 3-grooved, as is the upper part of the stipe. Bundles usually 7–9. Bipinnatifid. Veins forming a single row of areoles along the midribs of pinnae and lobes. 2–4 feet. Swamps and wet woods. (*Anchistea v.*)

II. **Bundles Irregularly Arranged.**

60.—*Pteridium latiusculum.* Stalk brownish, with a dense sheath of hairs below ground, just above the rhizome. Stipe flattened, and with one or two grooves in front. Rachis and secondary rachises 3-grooved. Stipe and rachises with light lines along the sides. Bundles curved, flat or oval, rather irregularly arranged. Ternate with bipinnate branches. 1–4 feet. Thickets, etc., usually in sandy soil. (*Pteris aquilina*).

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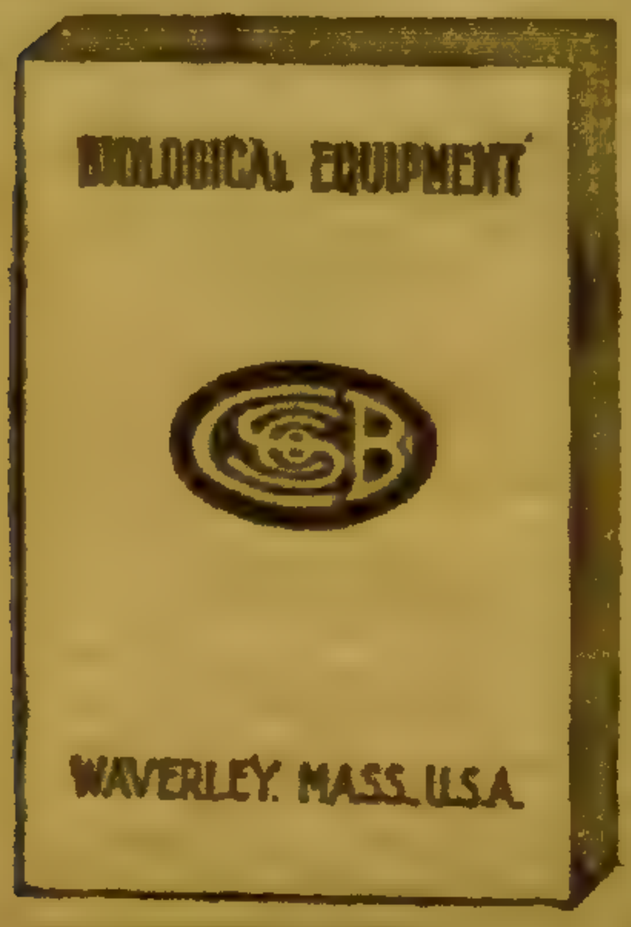

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A QUARTERLY DEVOTED TO FERNS

Published by the

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EDITORS

R. C. BENEDICT

E. J. WINSLOW C. A. WEATHERBY

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American Fern Journal

VOL. 18 JULY–SEPTEMBER, 1928 No. 3

Fluctuation in Equisetum*

JOHN H. SCHAFFNER

In making a comprehensive study of the taxonomy of plants, the fact becomes evident that there is no general correspondence between the taxonomic system and the phylogenetic process, or evolution, on the one hand, and the environment or utility, on the other. The evolutionary movement, in the broad sense, goes on in the same direction in widely diverse environments. The same progressive movements also take place independently of special morphological differences and often at different evolutionary horizons, as, for example, the origin of the flower or determinate reproductive axis. But another fact stands out with equal prominence. There is abundant ecological adaptation, as ability to withstand drought or cold, and also great fluctuation or ecological variation of the individual in many groups. In some the ontogeny is often remarkably influenced by the environment. Of all the groups of plants, which the writer has studied, the *Equisetaceae* seem to possess the greatest ability to fluctuate; and it is very important that those who are doing morphological or taxonomic work on the group take adequate account of this tendency to fluctua-

* Papers from the Department of Botany, The Ohio State University, No. 217. [Volume 18, No. 2, of the JOURNAL, pages 37–68, plate 1, was issued July 12, 1928.]

tion. It is often very great in characters that we are accustomed to think of as quite constant. This is probably due to the fact that *Equisetum* represents a primitive group which has developed a large number of specializations and even of advanced characters.

The keynote to the situation is primitive position in respect to fundamental evolutionary progression combined with important specializations. Among these specializations may be mentioned: development of prominent internodes and internodal cavities; development of leaf sheaths with loss of proper leaves; development of sterile and fertile shoots; development of branch whorls, and their suppression, on top of the more primitive sporadic monopodial branching system; the evolution of a peduncle and primitive perianth; and specialization in the loss of chlorophyll in the cone, peduncle, and reproductive shoot. *Equisetum* can, therefore, be defined as a specialized, primitive vascular plant.

If one studies the progressive changes in the various plant phyla, one soon finds that the first steps in a given direction are commonly much more subject to fluctuation than the more advanced evolutionary stages of the same category. Thus a primitive flower, like the cone of a Lycopod, Equisetum, Araucarian, or Larix, or even of a Rose, will frequently proliferate, returning to the primitive indeterminate condition, while such a development is exceedingly rare and practically impossible in the higher types of strobili and advanced flowers. The same condition holds in the dimorphism between foliage leaf and sporophyll. Intermediate expressions between leaf and sporophyll are rather common in such low forms as *Osmunda cinnamomea* and *Onoclea sensibilis*, while such intermediate forms would be very difficult to find in any advanced group unless a mutative change occurs. A primitive flower, which is just one step removed from

the original indeterminate condition, has great variability in the number of its sporophylls while a high type of flower has its parts exceedingly constant.

Since *Equisetum* has such a large number of these first steps in evolutionary advancement, one would expect the genus to be ideal for the study of fluctuation, and according to the writer's observation, as intimated above, its species appears to have a greater supply of important fluctuations than almost any other vascular plants. The real difficulty in studying *Equisetum* is to find something that can be depended upon.

1. FLUCTUATION IN THE SHEATH SEGMENTS AND INTERNODAL RIDGES. In most of the species the variability in these characters is very great, the numbers depending largely on the comparative size of the growing bud. It is only when the extreme species of the several phyletic series are reached that something like the stability characteristic of corresponding structures of higher plants is attained. In *E. praealtum* the teeth and ridges vary from 7 to 48, or even beyond these limits; in *E. variegatum* the numbers usually fluctuate between 5 to 12; while in E. *scirpoides*, the culmination of this species group, there are 6 ridges (3 double ridges) and 3 sheath segments and teeth quite regularly. In the more highly evolved EQUISETA HETEROPHYADICA, although the main stem is still quite variable, the normal branches approach a condition of constancy in sheath segments and internodal ridges, *E. pratense* mostly having 3 and *E. arvense* 3 or 4.

2. DISCOLORATION OF SHEATHS. No reliance is to be placed on the color patterns of the sheaths or sheath teeth of such species as *E. laevigatum*, *E. praealtum*, *E. hiemale* and *E. kansanum*, although these are frequently emphasized in keys and descriptions. In *E. praealtum* the whole sheath may be black or dark brown, or it may

be black with a very narrow white band at the base; it may be uniformly white or ash-colored; it may be light colored with a dark band above or below or with a band at both ends. *E. hiemale* shows similar fluctuations. Often several of these patterns will be on the same shoot. *E. laevigatum* typically has green sheaths until quite old, with narrow brown spots on the tips of the leaf segments, but the basal sheaths are often discolored in the same patterns developed in *E. praealtum*.

3. ABSCISSION OF SHEATH-TEETH. In those species which have deciduous teeth the formation of abscission layers is very variable both as to time of formation and completeness of the development. The condition ranges all the way from caducous to persistent teeth. In *E. praealtum* and *E. laevigatum* the abscission frequently occurs very early and the adnate teeth are carried up on the tip of the stem as "pagoda caps"; but often the teeth are long persistent and are still present as distinct appendages on old sheaths. In other cases, although the stem grows through the whorl of teeth, they soon drop off as individual members. Frequently the lowest sheaths have persistent teeth without any abscission layer developing.

4. FLUCTUATION IN LENGTH OF INTERNODES. The difference in length of internodes in a species is very great, and the fluctuation on a single shoot is often enormous, ranging from practically zero length to 5¼ inches and more in *E. praealtum*. In *E. praealtum*, *E. hiemale*, and *E. laevigatum* there may be two, three, four or more sheaths completely telescoped through lack of internodal development. Sometimes a zone of short internodes appears suddenly and ends suddenly, or the zone may show a gradual succession of elongating or shortening internodes. These zones may be near the base of the shoot, in the middle, or near the tip; or there may be

two or more such zones. Occasionally one can find a patch of plants in which nearly all of the shoots of a given year have a contracted zone in about the same region of the shoot, indicating some strong environmental influence acting at the time of development. Plants are also often developed quite regularly. In patches of *E. praealtum* with prevailingly white sheaths, the bands of shortened internodes present a striking appearance.

These short internodes are commonly discolored on the inner wall of the central cavity. Sometimes the color is yellowish-brown and sometimes very dark brown or nearly black. Occasionally, however, one or more cavities or even all in a zone may have the normal white appearance of the normal central cavity. The walls of the short cavity are also sometimes granular. This suggested that the short internodes might be caused by some sort of insect. But no evidence of any kind has been found.

5. FLUCTUATION IN BRANCH WHORLS. Those species which have regular whorls of branches often show striking variation in this character. This is especially true for *E. fluviatile* and *E. palustre*, either of which may show extensive branching with regular whorls, may be sporadically branched or may show no branching of the aerial shoot at all. The number of whorls of branches and their nearness to the base or apex is also exceedingly variable. There is also much fluctuation in the development of secondary branches. Compound branches are very common in *E. arvense* and of many degrees of complexity, while *E. silvaticum*, which normally has compound branches, may be simply branched. The whorled branch condition, phylogenetically considered, is an advanced condition imposed on a system with sporadic branching, as manifested in the rhizome.

6. GENERAL HABIT. The general habit varies greatly in most species, and especially in *E. fluviatile*, *E. palustre*, *E. laevigatum*, *E. kansanum*, *E. silvaticum*, *E. pratense*, *E. telmateia*, and *E. arvense*. In *E. silvaticum*, *E. pratense*, and *E. arvense*, the shoots may be tall with regular whorls of long or short branches; they may be irregularly branched and bushy or closely tufted, or they may even develop as typical mat plants lying flat on the ground with the main branches radiating from the center.

7. FLUCTUATION IN THE SILEX. The development of the silicious crust is very variable also, some individuals being comparatively smooth while others are exceedingly rough. There is often a considerable regional difference in this respect.

8. AMPLIATED SHEATH. In general the sheaths may be described as ampliated or tight. But the close-fitting, cylindrical sheaths are usually also ampliated or funnel-shaped when young, and may thus cause difficulty in determination. Well-developed specimens alone can give definite information as to the real nature of the sheath in a number of species.

9. INTERGRADATION BETWEEN VEGETATIVE AND FLORAL SHOOTS. All Equiseta have a dimorphism of shoots, definite, determinate, vegetative shoots and determinate reproductive or cone-bearing shoots. Since there is a rather primitive type of cone development, one would naturally expect to find some fluctuation between the two conditions. One is, however, hardly prepared for the extreme series of ontogenetic expressions, present in many species, by which every gradation of size and perfection is produced between the normal fertile cones and the determinate, vegetative tip. The sterile and semi-sterile cones vary from the size of a pin head to the size normal for the fertile cones of the species. The smallest

cones are on shoots with very slender tips. These fluctuating series are common in *E. laevigatum, E. praealtum, E. kansanum, E. fluviatile, E. palustre,* and even *E. pratense.* There are also integrading cone series in *E. silvaticum* and *E. arvense,* but they are rather rare in comparison with their frequency in such more primitive species as *E. praealtum, E. fluviatile,* and *E. palustre.*

These semi-sterile cones have in the past given rise to much speculation as to possible hybrid races in *Equisetum.* The forms known as *E. trachiodon, E. litorale,* and *E. variegatum jesupi* have been regarded as hybrids, apparently mainly because of imperfect spores and sporangia. There may be hybrids in *Equisetum* but, so far, I myself have never found any definite evidence of it. The way to settle the question is for someone to attempt the hybridizations. In attempting to discover possible hybrids, systematists must also learn to judge of the supposed hybrid characters by the modern principles of genetics and Mendelian heredity. The mere presence of semi-sterile shoots and of intermediate characters does not constitute evidence of hybridity in *Equisetum.*

10. THE CALYX AND SPOROPHYLLS. The *Equisetum* cone is made up of a series of separate sporophylls arranged in spirals and so placed that they fall into definite cycles. The numbers in a whorl usually decrease slightly from the middle to the base and decidedly so to the tip. A cone may have as few as 10 free sporophylls (minute sterile type) or even less, or as many as 214 or more in the large normal cones of *E. praealtum.* At the base there is a special sheath or calyx of united sporophylls bearing sporangia only on the upper side. The enormous fluctuation in the determinate growth of the cone is probably due to the fact that *Equisetum* has not evolved very far from the primitive indeterminate type.

The acquired potentiality of determination does not work promptly or accurately. Hence there is also much proliferation in some species, as in *E. fluviatile*. In the lower species, the calyx segments are normally all sporangium-bearing. Nevertheless in species like *E. praealtum* part of the segments may be completely sterile, and in extreme cases, although rarely, a completely sterile calyx is developed. This development of a special whorl of leaves between the sporophylls and vegetative leaves is one of the characteristics of the higher flowers.

In the highest Equiseta the calyx is normally entirely sterile and it is only occasionally that one can find one or more sporangia on it. In *E. arvense* and *E. pratense* one side of the bud may be more advanced than the other, so the sheath below the cone may be leaf sheath on one side and sterile calyx on the other. In such cases then the segments of the calyx in line above will also show the more advanced gradient and will have sporangia on the upper side, while the segments in line with the normal leaf sheath segments below will be sterile.

11. THE PEDUNCLE. The lower Equiseta usually have the cone sessile or nearly so in the uppermost leaf sheath, as can be observed in *E. laevigatum*, *E. praealtum*, and *E. hiemale*. The internode between the last leaf sheath and the calyx is commonly not more than one-fourth inch long. But beginning with the species with annual aerial shoots a peduncle is evolved which reaches its maximum in *E. telmateia* and *E. arvense*. In *E. kansanum*, and *E. fluviatile* the peduncle is often distinct and of some length, while in *E. palustre*, *E. silvaticum*, and *E. pratense* it is usually prominent. In all cases the fluctuation in length is very great. In the lower species the peduncle also fluctuates in texture and color from the ordinary green to yellowish and brown. In *E. arvense* the fluctuation in length is from less than one-half inch up to five inches and more.

12. TERMINAL POINT OF CONE. The lower Equiseta have apiculate cones while the higher species have rounded tips or are merely acute. Since *E. kansanum* and *E. funstoni* have apparently originated from the apiculate group and have eliminated the point with the acquisition of annual aerial shoots, this character becomes of diagnostic value, but, alas, just as is the case with the newly acquired sterile calyx and peduncle, so also can no absolute reliance be placed on the presence or absence of the apiculate cone, as in distinguishing between *E. laevigatum* and *E. kansanum*. For although the difference in this character is usually definite, extreme fluctuations overlap and one must, therefore, depend in such cases on the annual and perennial conditions of the stems. The development of the projection at the apex of the cone is to be understood as due to a slow process of determination. In the higher Equiseta determination of the floral axis is more prompt and definite and the point is thus eliminated, because the universal trend of floral evolution in all groups is to a more prompt cessation of growth after reproduction begins, until in the highest, epigynous type the central point of the floral axis actually stops growing before the incepts of the floral leaves have made their appearance.

13. LOSS OF CHLOROPHYLL IN REPRODUCTIVE SHOOT. In the lower species of *Equisetum* the cone is green until the spores reach maturity. As one ascends the scale, the loss of green color is shoved back farther and farther in the ontogeny until the extreme is reached in *E. telmateia* and *E. arvense*, where the entire reproductive shoot is normally without chlorophyll or with only very slight chlorophyll development. Along with the loss of chlorophyll goes the loss of the branch whorls in these species. But fluctuation is again prominent, for one can frequently find fertile shoots with varying degrees of branch development and varying degrees of chlorophyll.

Now, considering all this mass of fluctuating characters, where is one to turn to find something dependable for species characterization and delimitation? There are such characters which show no greater fluctuation than is present commonly in more fixed groups. These characters must be found and emphasized in keys and descriptions. And when this is done there is little left for varieties. There are practically no varieties in *Equisetum*. Yet a great number of them have been described. Seventy years ago Milde found 11 in *E. arvense*, 9 in *E. telmateia*, 34 in *E. ramosissimum*, 12 in *E. hiemale*, 13 in *E. variegatum*, 7 in *E. palustre* and 3 in *E. praealtum* (*robustum*). Many more have been described in the mean time. A. A. Eaton, who was our last prominent student of the group, realized that there were practically no good varieties recognizable in *Equisetum*, yet he immediately began to establish a large number of new ones.

Without going into the question of the validity of the taxonomic groups designated as "varieties" and "forms," which have played such a prominent part in the taxonomy of *Equisetum*, it becomes necessary to dispose of the fact of fluctuation in one way or another, whenever one is employed in naming or describing the various species which one may recognize as valid.

The writer is opposed to giving formal names to fluctuations, for it can easily be seen that not only will two shoots from the same rhizome often be placed in different groups but the same shoot must often be catalogued under several varietal names as is at present actually done! Such a procedure seems extremely foolish and the wonder is that it can actually be carried on in the name of taxonomic science.

The writer believes that the situation can be properly met by the use of descriptive polynomials. If Latin descriptive terms are deemed necessary, then the main

types of fluctuations can receive general descriptive designations, as *ramulosum*, *pauciramulosum*, *multiramulosum*, *nudum*, etc., to designate the degree of branching; *proliferum* for a proliferated cone; *polystachyum* for the presence of cones on lateral branches; *dichotomum* for a case of branch dichotomy or twinning, etc. Then if one finds an individual of *E. fluviatile* which has a shoot with many whorls of branches, a proliferated cone, and one or more side branches with cones, it would be *E. fluviatile* L. fl. *multiramulosum proliferum polystachyum*. Another shoot from the same rhizome may have no branches whatever but may have a dichotomous tip, each of the twin branches ending in a semi-sterile cone. This would be *E. fluviatile* L. fl. *nudum dichotomum semi-sterile*. In almost any large patch of *E. praealtum* one can find individual shoots with no branches and with a single terminal cone, but commonly or even quite generally, in Ohio, the older shoots develop lateral branches ending in small cones. The first shoot would then be *E. praealtum* Raf. fl. *nudum*, if one would not look for other fluctuating peculiarities, which would, of course, lengthen the designation, and the other type would be *E. praealtum* Raf. fl. *polystachyum*. And so on *ad infinitum*. This is exactly the same kind of taxonomic exercise as when one goes into an apple orchard and makes the unusual discovery that of three trees, one has an abundance of apples, the second one only a single apple, and the third tree no apples at all. This is an exercise in organographic ecology and not taxonomy. From the standpoint of ecology this is a legitimate and important pastime; from the standpoint of formal taxonomy, it is "nonsense botany." For if taxonomy is not naming and establishing larger and smaller groups which reproduce themselves after their kind, then it has no legitimate basis as a science.

COLUMBUS, OHIO

Ferning Out of Season

H. E. RANSIER

We started out November 26th, 1927, with car and trailer, an aggregate weight of three full tons. Rain overtook us the first night out, before a camp ground had been located in the darkness, and for a whole month it was a fight against rain, snow, sleet and cold. While in camp at Harper's Ferry four inches of snow and sleet fell. Imagine our surprise to find purple cliff brakes in all stages of growth on the face of a retaining wall along a side street, rubbing pedestrians' elbows as they passed!

The cliffs above would no doubt have been interesting to examine but the sun had already come out, the snow and ice were melting, and masses were slipping down the face of the wall, absolutely barring investigation.

No ferns were seen in any of the Virginia Caverns visited but it was interesting to note that often where 100- or 200-watt or larger electric lamps with reflectors had been installed close to the clay-covered formations, the heat and light of the lamps, combined with the natural moisture present, had favored low forms of plant life, an inch or so high, over a space the size of a dinner plate, pale green. Three or four kinds may be seen but none were identified. As the lights are on but a few minutes while visitors are passing, the results are astonishing.

Our next thrill was in finding venus-hair ferns on the outer walls of Fort Marion, St. Augustine, Florida, in great quantities, though not growing thriftily. Most unusual of all was to find that it grew much finer on the inner walls of rooms of this coquina-rock-built fortress. The fort consists of a large inner court, around which are chambers approximately thirty feet deep, all facing the court, each with one door and usually a window on

each side of the door, with prison-like gratings only allowing free circulation of air and a dim light. These chambers are possibly sixteen feet high with rock arched ceilings and all have a history. One, for instance, was Osceola's cell. In a number of these rooms the venus-hair fern had found a congenial home, even growing from seams in the wall at the extreme rear end and along the sides as well as nearer the door. (See Fig. 4.)

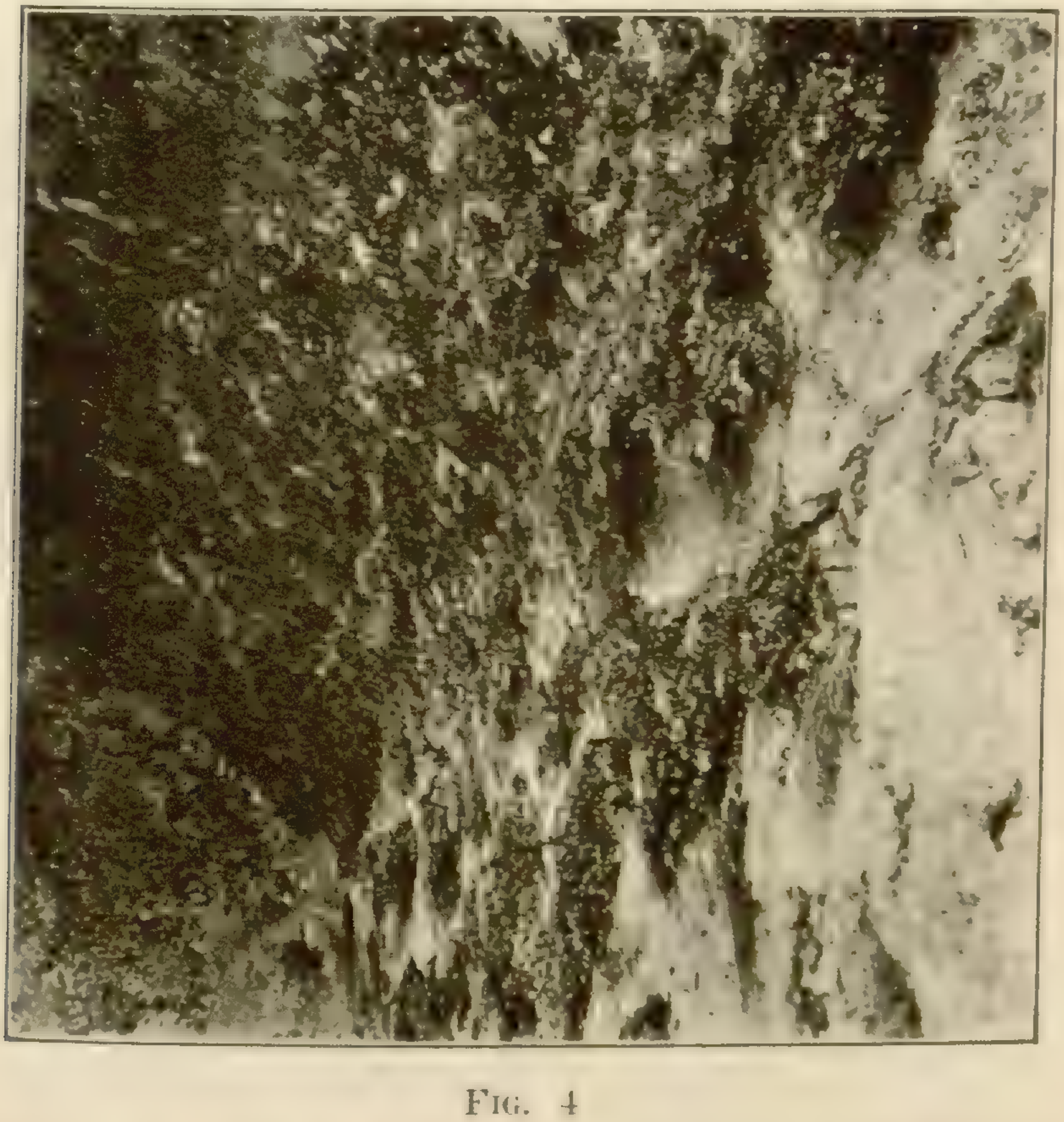

FIG. 4

The place had had repairs made upon the flat roof overhead and the rooms fumigated, and, as a result, the ferns had suffered, much to the custodian's sorrow. He thought it was the fumigation but I suggested that the repairs of tar and cement overhead had probably cut off the moisture from filtering down through the porous

VENUS-HAIR ON THE OLD CITY GATES, ST. AUGUSTINE

rock and that drilling a hole to allow a little water to reach them would restore growth. They had enjoyed shade, moisture and protection from the occasional frosts, an ideal home.

After some delay and difficulty, permission was obtained to make flashlights of the ferns, but when the attempt was made, an accident put the kodak out of commission and the results were but partially successful.

The old Spanish gates to the city of St. Augustine are still standing, built of the same kind of rock as the fort and on the northern side the venus-hair also grows freely, close beside the modern paved highway where the city's visitors flash by, or perchance the languid native leans against them while chatting with his fellows. However, the colored loiterer would never harm the ferns, for he would surely be found on the southern or sunny side of the wall!

The fort is used by the local Historical Society with the Government's permission and capable guides show great numbers of visitors daily through without charge, although voluntary offerings are customary. Booths where postals, views and curios are sold are located near the entrance. Under the circumstances, it seems strange that these ferns have not been reported by some visitor before this.

Around Miami, Florida, I began to find ferns but on January 29th there was a frost, three-eighths of an inch of ice forming on our water pail, and all ferns were cut down.

A large drainage canal from near Royal Palm Park, south of Miami to the southern tip of the state, was dug out of shell rock, part of the rock being used for a road bed parallelling the canal, and the balance thrown up on the opposite bank. Several kinds of ferns have taken to this rock as ducks take to water.

The Author and the Leather-ferns. Sterile, Left; Fertile, Right

About ten miles from the gulf the leather fern grew very close to the roadway but mosquitoes made it almost impossible to do more than grab a specimen and run. Usually there was but one fertile frond and more often none but sterile. The latter sometimes were thirty inches across and not much over six feet tall. Fertile fronds are much narrower and may be much taller. Some found on our return north near Fort Pierce were nearly nine feet tall, but the choicest of all were found just north of Fort Myers on the west coast, which measured exactly ten feet eight inches in height. It was collected in a rain storm, under an umbrella, hip boots on, about a hundred feet off the main highway. Some have been reported twelve feet high. One measured four inches in circumference at the base of the stipe! Making photos on the spot would have necessitated an hour's labor with a scythe or machete. Being among them was much like being lost in a corn field. After emerging with specimens at one place, we were informed that a rattlesnake had been killed there very recently. (Never saw one, though, in Florida except at a snake farm.)

South of Tallahassee is said to be the largest spring in the world, discharging 370,000 gallons of water a minute, Wakulla Spring. Returning from a visit there, along a narrow woods road, a negro cabin was espied, the roof of which was almost wholly overgrown with the gray polypody fern, in vigorous condition. It had been noticed on live oak tree trunks, on the larger limbs, logs and palmetto trunks as well as on rocks, but these on the roof were the most unique and massive lot of all. It rambles over tree trunks, and, while frequently met with, was more often curled up and partially dry at the time of my visit.

BIRMINGHAM, ALABAMA

Gray Polypody on a Cabin Roof

Ferns of Monroe and Adjoining Counties, New York (continued)

JOSEPHINE ZOLLMAN EDSON

ASPLENIUM ANGUSTIFOLIUM Michx. Occasional.

This fern, much like *Polystichum acrostichoides* in outline save that its pinnae lack the auricle near the rachis, has been found in moist woods at Ionia, Fairport and Webster.

ASPLENIUM ACROSTICHOIDES Sw. Frequent.

In moist woods at Fisher's, Ionia and Fairport may be found this attractive fern.

ASPLENIUM FILIX-FEMINA (L.) Bernh. Common.

Almost anywhere, in dry woods, we find the graceful lady fern. Three of my favorite hunting grounds for it are the Marsh Road Woods, Perinton, Townline Road, Chili, and the woods about the Mendon Ponds.

CAMPTOSORUS RHIZOPHYLLUS (L.) Link. Rare.

The habit of the walking fern of rooting at the ribbon-like ends of its fronds gives one the impression of a Mother Fern leading her little ones by the hand, along the slippery, dangerous limestone cliffs. On the sides of ravines at the Gulf, LeRoy and Clark's Gully, Naples and on rocks in Penfield this interesting fern can be found.

POLYSTICHUM ACROSTICHOIDES (Michx.) Schott. Common.

Var. INCISUM Gray. Occasional.

Polystichum acrostichoides is one of the ferns most frequently found in our locality, but none the less interesting for that. Beside being evergreen it is extremely

variable. One may find fronds all crinkled and scalloped or, upon examining an especially attractive fern, discover several forked fronds. Some have blunt rounded pinnae, others display pinnae deeply incised or with prominent spiny hairs.

ASPIDIUM THELYPTERIS (L.) Sw. Common.

In wet woods everywhere, and in Bergen Swamp and Mendon Ponds in particular, one may find the marsh fern waving a greeting to the passerby.

ASPIDIUM NOVEBORACENSE (L.) Sw. Common.

This fern, with its easily identified, tapering fronds, carpets a moist woods on the Townline Road, Chili, a few miles from Rochester.

There is also a fragrant variety of this fern which, to quote from Clute: "Prof. Peck has described a variety *fragrans* of the New York fern which is principally distinguished by the odour . . . Eaton made a variety *suaveolens* of which he says, 'Fronds narrower, slightly more rigid, very sweet scented in drying, the under surface copiously sprinkled with minute glands.' This is apparently only a form which, exposed to the sun, has made some slight changes to adapt itself to the new conditions."

ASPIDIUM MARGINALE (L.) Sw. Common.

Marginale is one of our ten evergreen ferns and is an inhabitant of dry woods at Honeoye Lake, Marsh Road, Perinton and an arbor vitae swamp in Chili.

ASPIDIUM GOLDIANUM Hook. Frequent.

This is one of our largest ferns, specimens at the Gulf, LeRoy, attaining a height of from three to four feet. It is also found in moist woods at Webster and Adams Basin.

ASPIDIUM BOOTTII Tuckerm. Rare.

This is an inhabitant of moist woods at the Powder Mills, Ontario County, and an arbor vitae swamp in Chili, Monroe County.

ASPIDIUM CRISTATUM (L.) Sw. Frequent.

Distinctive, due to its prominent venation, *Aspidium cristatum* graces the moist woods at Adams Basin, Powder Mills, and the Bergen Swamp. It is an evergreen fern and cheers the winter walker with its bright, sterile fronds prostrate upon the leafy earth.

ASPIDIUM CRISTATUM Var. CLINTONIANUM D. C. Eaton. Occasional.

In an arbor vitae swamp, Chili, Genesee River Wood, Greece and in Adams Basin can be found this, the Clinton's wood fern. It is a lover of moist woodlands, wherever found.

ASPIDIUM SPINULOSUM (O. F. Müller) Sw. Occasional.

At Sullivan's, the arbor vitae swamp, Chili, and Cedar Swamp, Henrietta, one may seek out the spinulose wood fern and be sure of finding it at home in the cold, wet woods which it loves.

ASPIDIUM SPINULOSUM Var. INTERMEDIUM (Muhl.) D. C. Eaton. Common.

This is our commonest wood fern and its evergreen fronds are often met with on our winter hikes. It has been found in the arbor vitae swamp, Chili, Honeoye Lake and Marsh Road, Perinton.

CYSTOPTERIS BULBIFERA (L.) Bernh. Frequent.

This interesting fern can be met with at the Gulf, LeRoy, arbor vitae swamp, Chili or Clark's Gully, Naples, growing in its moist, rocky ravine-homes.

CYSTOPTERIS FRAGILIS (L.) Bernh. Common.

Fragilis adorns moist banks and cliff faces with a dainty, lace-like fringe. It brings to mind a picture of moist, dripping rocks bright with columbine. When encountered in the haunts of *Woodsia obtusa* it is frequently confused with that fern.

WOODSIA ILVENSIS (L.) R. Br. Rare.

This little rusty-fronded fern is a very unusual sight in this locality. Prof. Elon Eaton has found one station for it on the west side of Canandaigua Lake in Ontario County.

DICKSONIA PUNCTILOBULA (Michx.) Gray. Rare.

Unlike the Dicksonia of the Adirondacks and Vermont, which favors sunny, boulder-strewn pastures, ours seeks out dry woods in which to display its dainty, lacy fronds. In the woods, near the shore of Lake Lacoma, dwells a community of the Dicksonia through which a woodland path fragrantly leads.

There are two other stations for this fern, one in Webster and one at Honeoye Lake.

ONOCLEA SENSIBILIS L. Common.

If brought into the fern-garden this fern is very prone to make a nuisance of itself. Its rootsock creeps along beneath the surface of the ground and lo! in an unexpected quarter another fern springs up. This fern also displays many interesting forms of its fronds.

ONOCLEA STRUTHIOPTERIS (L.) Hoffm. Common.

The ostrich fern is the possessor of a very aggressive personality and is liable to wear out its welcome in the fern-bed by crowding out its weaker neighbors. It enjoys wet woods and can be found at Golah, Lake Lacoma or at Canadice Heights.

OSMUNDA REGALIS L. Common.

On hummocks in shallow water one may find the stately royal fern in the wood on the Townline road, Chili at Honeoye Lake or the Mendon Ponds. A form with a fruiting portion on one of the pinnae was found, by myself, at Sullivan's, Ontario County, in 1923.

OSMUNDA CLAYTONIANA L. Common.

One of the ferns most commonly seen in cultivation as it will thrive in almost any soil. We find it most abundantly in dry woods at Canadice Heights and Lake Lacoma. I read that it is also found in China and India.

OSMUNDA CINNAMOMEA L. Common.

The cinnamon fern prefers a moist soil for its home, and we find it in the woods on the Townline Road, Chili, Marsh Road, Perinton or the Bergen Swamp. Its light-green fronds form a fitting vase for its cinnamon plume.

An unusual form of this fern was found at Mud Pond, Wayne County, in 1927. The frond has the typical shape of *Osmunda cinnamomea,* but has a dense, whitish pubescence along the veins toward the outer margins of the pinnules, more apparent near the tip of the frond. Above the center of the frond the pinnae grow farther apart and the pinnules become noticeably smaller until they become mere scalloped, green and white frills on either side of the midvein.

OPHIOGLOSSUM VULGATUM L. Local.

This fern has been found at the Mendon Ponds, Bergen Swamp and Adams Basin.

Apparently this fern remains dormant for a season. One year it may be plentiful in its chosen location and the next only a few, straggling specimens come to light.

Of this Clute states: "The curious manner in which the adder's-tongue appears and disappears in the same

spot in different years has given ground for the belief that the plants occasionally rest for a season. It is also conjectured that the prothallia may form resting bodies as the prothallia of certain other species of ferns are known to do.''

BOTRYCHIUM LANCEOLATUM (Gmel.) Angstroem. Local.

This fern has been found in the moist woods at Holley, Orleans County.

BOTRYCHIUM RAMOSUM (Roth) Aschers. Local.

This little Botrychium has founded a moist, hummocky community of several hundred at Mud Pond, Wayne County, sweet with the musky odor of hemlock and leaf-mould. Here they thrive, from tiny mites to those of goodly stature. It has also been found in a station at Webster.

BOTRYCHIUM OBLIQUUM Muhl. Frequent.

In the Marsh Road, Perinton Wood and at Adams Basin we have discovered this little fern. On a December hike in the woods I have found it as green as if frost was not, its roots just under the leaf-mould with just the tips in the earth.

BOTRYCHIUM TERNATUM (Thunb.) Sw. Occasional.

In a moist pasture at Irondequoit Bay, Monroe County, this Botrychium has been found and admired.

BOTRYCHIUM VIRGINIANUM (L.) Sw. Common.

In the dry woods at Canadice Heights and Honeoye Lake in Ontario County and the moist woods on the Townline Road, Chili, I have encountered this lacy fern. It is the Botrychium everyone interested in the wildings has seen oftenest and knows the best.

The following hybrids were first collected in this locality by Milton S. Baxter, of Rochester, New York:

ASPIDIUM GOLDIANUM × MARGINALE. Scarce.
Woods on the Lower Genesee River. Habitat: Wet woods.

A. CRISTATUM × MARGINALE. Scarce.
Arbor vitae swamp, Chili. Habitat: Swampy woods.

A. CRISTATUM, Var. CLINTONIANUM × GOLDIANUM. Scarce.
Arbor vitae swamp, Chili. Habitat: Swampy woods.

A. CRISTATUM, Var. CLINTONIANUM × SPINULOSUM. Scarce.
Arbor vitae swamp, Chili. Habitat: Swampy woods.

A. CRISTATUM, Var. CLINTONIANUM × SPINULOSUM, Var. INTERMEDIUM. Scarce.
Arbor vitae swamp, Chili. Habitat: Swampy woods.

A. GOLDIANUM × MARGINALE. Rare.
Perinton. Habitat: Dry woods.
Only one plant of this hybrid has been seen.

A. MARGINALE × SPINULOSUM, Var. INTERMEDIUM. Scarce.
Hipp Brook Valley, Penfield. Habitat: Dry woods.

ROCHESTER, N. Y.

Recent Fern Literature

Prof. M. L. Fernald has published two more studies of North American ferns. In one, he takes up the question of the identity of the American plant, of Alleghanian range, which has long passed as *Asplenium Ruta-muraria*, and the species of western Eurasia to which the name properly belongs. Plants with just these ranges are rarely quite the same; in this case Prof. Fernald finds differences in rootstocks, scales, margins of fronds, and spores, which, though slight in themselves, when taken together justify the separation of the American plant as a new species, to which he gives the name *A. cryptolepis*. This is usually quite constant in foliage, as in other characters; in Ohio, however, occurs a form with lanceolate segments having long-attenuate tips, which Prof. Fernald distinguishes as var. *ohionis*.

In the second study, the alpine lady-fern, *Athyrium alpestre*, is discussed. Prof. Fernald does not agree with Dr. Maxon (AMER. FERN JOURN. **8**: 120, 1918) that the American phase of this plant is a species distinct from the European; nor does he wholly concur with Prof. Butters (Rhodora **19**: 204, 1917) in referring all American specimens to a var. *americanum*. He finds that certain specimens of his own collecting from Newfoundland cannot be separated from the typical *A. alpestre* of Europe; and that in addition to true var. *americanum* of western North America, there is a second variety, distinguished by its proportionately broader fronds and somewhat finer cutting, which occurs in the Gaspé Peninsula of Quebec and is accordingly called var. *gaspensis*. All are illustrated by fine photographs of herbarium specimens, taken by Prof. J. F. Collins.[1]

[1] Fernald, M. L. The American representative of *Asplenium Ruta-muraria*. The eastern American occurrence of *Athyrium alpestre*. Rhodora **30**: 37–49. Pls. 161–168. 1928.

In a recent number of The Victorian Naturalist[2] Mr. F. G. A. Barnard has written interestingly of *Botrychium australe* R. Br., under the title "The Story of a Meadow Moonwort," giving an account of the cultivation of a plant of this rare Australian species for a period of forty years. Several individuals were discovered on an excursion of the Field Naturalists' Club of Victoria in September, 1887, as duly chronicled at the time, the plant under discussion being one of these. It was at once planted in a five-inch pot, and has since maintained itself perfectly in the half-shade of a lath fernery. On two or three occasions it has been repotted, but more frequently, as required, only the surface soil has been renewed. "As regularly as clockwork," writes the author, it puts forth its new frond the second week in February, and this lasts until December, when it turns yellow, withers, and dies. The frondless resting period is thus very short; but this, the writer suggests, is probably owing to the unusual amount of shade and moisture furnished it. "In the open its growing period would probably be shorter and its resting period longer, and this is likely to be the reason why it is apparently so rare."

Can any of our readers match this account of *Botrychium* as a potted plant?—WILLIAM R. MAXON.

THE HARDINESS OF HARDY FERNS.—In the spring of 1927 I had occasion to study the effect of late frosts on the first fronds that appear on some of our hardy ferns. It is surprising to see the difference in resistance in such as *Dryopteris*, *Osmunda*, *Athyrium*, and *Adiantum*.

Early in April spring-like weather set in, which started many of the ferns. The last of the month we had three nights when the thermometer dropped several

[2] 44: 197–199. 1927.

degrees below 30 and the ground froze. I have twenty-three varieties of ferns growing in a garden near the house. Those on which the frost seemed to have no effect were the two bladder ferns, the maiden-hair, and the royal fern. *Osmunda regalis*, eighteen inches high with fronds nearly spread open, and *Adiantum pedatum*, with tender-looking fronds just unrolling, paid no attention to the cold. *Athyrium angustum* had many fronds open and about one-third of them were killed. *Athyrium thelypteroides* was still under the ground. So were *Dryopteris Goldiana* and *D. Thelypteris*. But the ones which suffered most were those hardy Polystichums and Dryopteris. I have a fine plant of *Polystichum Braunii* which I obtained from Mrs. Somerville, of Superior, Wisconsin. Last year it put up four fronds, but this year it was sending up eleven fronds. I thought of course that, coming from the north, it would not be affected in the least. How surprised I was to see the frost had killed all but three fronds and two of those were damaged! The one least damaged was the one not yet unrolled. *Polystichum acrostichoides* was served about the same way. *Dryopteris spinulosa* with *intermedia* was just coming through the ground. Some of the plants were a little farther advanced and suffered for their early rising, as all that were above ground were killed. *D. marginalis* was just emerging from its leafy bed and those fronds fartherest advanced were killed. *Phegopteris hexagonoptera* had sent three fronds up, two of which were nearly developed; these were not affected, but one just unrolling was killed. *Osmunda Claytoniana* had about one-third of its fronds frozen.

The Polystichums produced more fronds during the summer; so did the Dryopteris, with the exception of *D. marginalis*, which did not seem to recover fully and produce as many fronds as usual.

This test seemed to prove that those ferns which are apparently most tender and are the first to succumb to early fall frosts, will while in their young state resist hard freezing. But those hardy Polystichums and Dryopteris which remain green through the winter are very tender in their early stage of development.—E. W. GRAVES, *Bentonsport, Iowa.*

A REPORT OF THE IOWA BOTRYCHIUMS.—In 1927 I reported through the FERN JOURNAL finding a colony of thirty-one plants of *Botrychium dissectum* also a colony of forty-eight *B. obliquum* about two miles apart.

During the summer and fall of this past year I have explored many of the wooded creek-bottom lands, hoping I might locate other colonies. Although I have spent considerable time searching the surrounding country for miles, I have been unsuccessful in finding any more plants. It seems very queer that I should find a good-sized colony of both ferns within a month's time, and since have spent days carefully exploring similar places, yet failed to reveal a single plant. It indicates to me that the Botrychiums are rare in Van Buren County.

I have kept a close tab on the two colonies the past year, and I find *B. dissectum* has made an increase in numbers while *B. obliquum* has decreased. August 20th I counted forty-five plants of *B. dissectum*, an increase of fourteen over the year before. Twenty-three of the plants were large enough to show plainly they belonged to the *B. dissectum* group. The remaining twenty-two were small plants. Perhaps a dozen or more had come from spores this year, as one plant had produced a fruiting spike and had cast its spores the fall before.

The plants in the colony of *B. obliquum* were counted August 20th and I could find only thirty-one plants, or seventeen plants less than last year. As I had dug up

five the year before that left only a loss of twelve plants, due perhaps to cattle walking over them. There were no plants in either colony that produced fertile spikes this year, and why I cannot tell, as the spring was exceptionally wet even as late as the last of May. All the plants in the colony of *B. obliquum* were true *obliquum*, no *dissectum* were found among them.—E. W. GRAVES, *Bentonsport, Iowa.*

RABBITS EAT EQUISETUM PRAEALTUM.—In March, I frequently visited the large patch of *E. praealtum* Raf. which grows in a ravine north of Columbus, Ohio. A number of rabbits make their home in this patch which covers a number of acres of ground and is criss-crossed by their well-beaten runways. These paths were in some places actually carpeted with Equisetum shoots which had been bitten off from the sides of the galleries. At various places, masses of refuse, consisting of one or more internodes but commonly of short pieces containing the dry sheath and the node, were seen. Usually at these places there were also abundant rabbit droppings. Although I did not see the rabbits eating the scouring-rushes, there is no doubt whatever that the main food, and perhaps the only thing in the daily menu at this time of the year, is Equisetum stems for all the rabbits living in the patch. Some of the rabbit droppings were examined under the compound microscope and were found, apparently, to consist entirely of small flakes and chips of the silicious epidermal cell walls, and pieces of vascular bundles of the *Equisetum praealtum.* The silicious walls were too much for the digestive ability of the rabbits and had passed through unchanged, so that all the epidermal characteristics of stomata, tubercles, and ridges were in perfect condition, although the food elements had probably been mostly extracted from the

cells. Since during the winter the central cavities of this Equisetum are more or less completely filled with water or ice, the rabbits have a feast of food and drink with the least amount of exertion on their part. I do not have a pet rabbit at home, otherwise he would certainly have had to demonstrate his ability to enjoy a supper of Equisetum or else go to bed hungry.—JOHN H. SCHAFFNER, *Columbus, Ohio.*

WHAT LUCK HAVE YOU HAD IN NATURALIZING HART'S TONGUE PLANTS?—With the shipment of a few plants this spring, the last of the first culture of sporeling Hart's Tongue plants at the Brooklyn Botanic Garden have been distributed for naturalization purposes. It will now be extremely interesting to hear the record of success,—and failure,—from those who have set out any of these plants. It will be valuable to compile a rather complete report covering practically all the plants that were shipped and request is hereby made to everyone who has set out live Hart's Tongue plants in the last few years, either the native specimens which Mr. Ransier sent out, or the sporelings sent out by the Brooklyn Botanic Garden, to answer the following questions.

Have your plants lived or died? If the latter, a brief note of explanation if you can give it as to the cause of the failure will be helpful. If your plants have lived, have they increased in size, both in numbers and dimensions of leaves?

It will also be interesting to keep rather close track of this experiment in naturalization and conservation. It is the intention now to start a new spore culture from which young plants should be available in about a year. The intervening period will afford a useful opportunity for report and evaluation of the success of the first distribution.

Another *Leaflet* dealing in general with plant conservation, and with special reference to the Jamesville-Green Lake Hart's Tongue situation, was published by the Brooklyn Botanic Garden this spring. A copy will be sent to any one interested enough to send 3c. postage.—R. C. BENEDICT.

THE FIRST NEW YORK ORCHID SHOW.—The first New York Orchid Show may be reported upon briefly in these pages, because under the heading of Foliage Plants there was included one class calling for a collection of native ferns. Only one exhibit was entered in this class, by W. A. Manda, with a representation of a dozen or so hardy American species which had been brought forward to full leafage for the purposes of this show.

The Orchid Show itself was noteworthy in a number of ways. First, it comprised the largest collection of tropical orchids ever shown at one time. The walls of a large exhibition hall, at least 200 feet in length, were completely banked with well-arranged displays of exotic orchid species and varieties; and besides these, the middle of the hall afforded space for three other lines of plants and cut specimens. A considerable number of native orchids were shown. One collection included *Arethusa, Calypso, Liparis, Leptorchis, Cypripedium arietinum* and half a dozen others, all brought to flower.

The chief exhibitor was Mr. Albert C. Burrage, who is also one of our Fern Society members.—R. C. BENEDICT.

"SKELETONIZED" FRONDS OF ASPLENIUM FILIX-FEMINA.—In "One Joyful Afternoon and its Spoils" (AMERICAN FERN JOURNAL, Vol. 18, p. 29), Maud L. Chisholm illustrates and describes a "skeletonized" frond of *Asplenuim Filix-femina* and inquires if any one else has come upon the form.

Some years ago I collected a similar form in Vermont and a sheet is in my herbarium, but, as all of my mounted specimens with their data are in Vermont, I cannot say authoritatively just when or where it was collected or if it is more or less skeletonized than the one illustrated.

As I have known the species it is very variable in the shape of the fronds. If memory serves me no tricks *Aspidium marginale* is also subject to this form of frond to a greater or less extent.—LESTON A. WHEELER, *R. F. D. 2, Bethel, Maine.*

American Fern Society

Members of the Fern Society will be interested in the letter which follows, from Dr. F. W. Stansfield, Editor of the *British Fern Gazette* and Honorable Secretary of the British Pteridological Society. Probably some of our members will be interested to ask for sample copies of the *Fern Gazette*, and some may like to join the British Society. We are making a reciprocal offer, to be brought to the attention of the members of the British Society.

"I am glad to learn some of the members of the American Fern Society are interested in our activities. In this small and crowded country the range and distribution of the species is pretty well ascertained and our main interest is in the study of variation and its biology. We have already had several examples of variation from the American continent and I feel sure that some of your members at least might find it worth their while to take up this branch of the subject. We shall at all times be glad to learn of your proceedings and I shall be glad at any time to send specimen copies of our Gazette to inquirers in America as in this country."

Isabel (Mrs. Ernest C.) Brown, a member of the Society since 1926, died at her home in Copake, N. Y., April 3, 1928, in her sixty-eighth year. Mrs. Brown was a Shakesperian student of note, especially interested in the Baconian theory. She had published a number of short articles on various phases of this subject, and one book ("Law Sports at Gray's Inn (1594)") which attracted attention both here and abroad as having tapped a new vein of scholarship, and for the skill and power of impartial sifting of evidence which it showed. Yet so modest and so little desirous of personal credit was she that all her work was published under a pen name and some even of her close associates did not know it was hers until some time after it was published.

Much of Mrs. Brown's leisure time was spent in gardening; she planned the ample grounds about her house at Copake, often taking part in the actual manual labor of arranging them, and had gathered there a collection of the native plants which grew on the property, to the number of more than a hundred species. In cultivating them she had that seemingly instinctive success which is granted to some favored ones.

She is buried on the estate in a place of her own choosing, among the trees and flowers and ferns which she had worked over and cared for.

Mr. Allan MacCaskill, Jr., Coleraine, Victoria, Australia, wishes to get specimens of rare grasses and sedges of the United States, especially *Erianthus* and *Eriophorum*, for study. Can any of our members help supply him?

Mr. MacCaskill also writes us that he proposes to make a continuing gift to the JOURNAL of four shillings each year above his regular membership dues, to be used toward extra pages and illustrations. Nothing pleases

and helps us more than such support of the JOURNAL; Mr. MacCaskill has our best thanks.

New members:

Clark, Mrs. P. B., 171 Marlboro St., Boston, Mass.

Featherly, H. I., Dept. of Botany, Oklahoma Agric. and Mech. College, Stillwater, Okla.

Hart, Bertrand K., 32 Dudley St., Fall River, Mass.

Changes of address:

Wheeler, Dr. Edward J., 136 Lancaster St., Albany, N. Y.

Grout, Dr. A. J., 1 Vine St., New Brighton, Staten Island, N. Y.

With the 1928 meeting of the Association for the Advancement of Science to be held in New York the week following Christmas, the American Fern Society is planning a meeting and get-together, which it is hoped may bring out a large number of members. A special committee on arrangements is working on the program, and will send detailed notice later. It is practically certain that our meeting will come in the latter part of convocation week, i.e., Thursday or Friday. Members who can come are urged to send notice in advance to R. C. Benedict, Brooklyn Botanic Garden. There will be a place in the program for the display of specimens of special interest and for the discussion of experiences. Visits to the fern houses of the New York and Brooklyn Botanic Gardens can easily be arranged in addition to any other meeting which may be scheduled.—R. C. BENEDICT, *for the Committee on Arrangements.*

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R. C. BENEDICT

E. J. WINSLOW C. A. WEATHERBY

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American Fern Journal

VOL. 18 OCTOBER–DECEMBER, 1928 No. 4

Ferns and Fern Allies in Wisconsin

DR. W. N. STEIL,

Professor of Botany, Marquette University,

AND

A. M. FULLER,

Assistant Curator, Milwaukee Public Museum

A quarter of a century ago, Wisconsin possessed a rich and abundant fern flora. Then in the numerous gorges cut into the solid calcareous sandstone cliffs along the Wisconsin River, especially in the region of the "Dells" at Kilbourn, many species of ferns grew and in large numbers. In the gorges and glens, all of the favorable conditions of soil, moisture, light and shade were supplied by nature for any stage in the life history of a fern or for the mature plants of any species. Here, perhaps, as nowhere else in the State, twenty-seven species flourished. It was, it seemed, a veritable Paradise for ferns.

Overhanging the moist shaded cliffs, or high up on the nearly bare rocks and exposed to the direct rays of the summer sun grew that much sought for fragrant fern, *Aspidium fragrans*. It was so abundant that vandals carried it away by the basketful. In some cases, it was planted but perhaps seldom grew, and no one guilty of transplanting the fern from its natural habitat, can boast of a single living specimen. The devastation

[Volume 18, No. 3 of the JOURNAL, pages 69–104, figures 4–8, was issued August 30, 1928.]

St. Croix River, Polk County. Aspidium fragrans and Woodsia Cathcartiana are to be found on these sheer trap rock walls.

(Courtesy of the Milwaukee Public Museum)

was so complete, that one considers himself fortunate if he can locate even a plant in the whole "Dells" country.

Although the ferns in this ideal habitat have suffered, as elsewhere in the state, nearly all the species still survive and some in abundance. In the crevices of the rocks, *Asplenium trichomanes*, once so abundant, may still be occasionally found. *A. acrostichoides, A. filix-femina, Aspidium marginale, A. spinulosum* and its variety, *Adiantum pedatum, Polypodium vulgare, Osmunda claytoniana* and *Botrychium virginianum*, are more common than any of the other of the twenty-seven species listed for this region.

Along the cliffs of the St. Croix River is another locality which still possesses many fern species. Here, too, one may find, now and then, a colony of the fragrant fern. Numerous other species, as in the Wisconsin Dells, have survived and grow in abundance. Fortunately, the region about the St. Croix has been acquired by the State and set aside as a park. Now we may hope that the natural environment of this beautiful spot with its rich flora including the Pteridophytes will be preserved.

There are other favorite haunts of ferns and their allies in Wisconsin. However, as more land is cleared, and swamps are drained, their natural habitats are limited in area. Then, too, the cold hand of commercialism is robbing the state of some of its Pteridophytes, especially *Aspidium spinulosum, Lycopodium clavatum* and *L. obscurum*. Although this group of plants is losing ground, it would not be impossible at present to make a complete collection of all those which the writers have listed and of which there are specimens in the herbaria of the Departments of Botany of the Milwaukee Public Museum, Marquette University, the University of Wisconsin, the Field Museum of Natural History, Arnold Arboretum, and Beloit College.

County Map of Wisconsin.

Wisconsin has seventy-one counties. In area they range from two hundred and thirty-five square miles to one thousand five hundred and fifty-four square miles. The total area is over fifty-five thousand square miles. The Pteridophytes of the southern and eastern portion of the State are well represented in the various herbaria.

In the following pages no definite data is given regarding the locality, collectors and year of collection of those species which are abundant and occur in all parts of the State. Definite data is given in connection with those species which are rare, or local, or confined to certain areas.

OPHIOGLOSSACEAE

OPHIOGLOSSUM VULGATUM L. This fern has been collected several times in the State. The writers are of the opinion that if a careful search were made for it in the latter part of June, when the species is in fruit, that new stations could be located. In June, 1922, Fuller found a colony of a dozen plants along a railroad right-of-way near Madison, Dane County. Cheney in 1892 had located a colony in the vicinity of Madison. In 1916, Goessl found a large colony at Marinette growing in the moist sand along the shore of Green Bay.

BOTRYCHIUM LANCEOLATUM (Gmel.) Angstroem, var. ANGUSTISEGMENTUM Pease and Moore. Goessl collected this fern near Prentice, Price County, in 1915.

BOTRYCHIUM LUNARIA (L.) Sw. Brown (*Schuette, 1889*) and Bayfield (*Cheney, 1897*) Counties.

BOTRYCHIUM OBLIQUUM Muhl. Bayfield (*Davis, 1923*), Dane (*Field Club, 1901*), Door (*Goessl, 1916*), Langlade (*Goessl, 1916*), Lincoln (*Goessl, 1915*), Marinette (*Goessl, 1916*), Milwaukee (*Hasse*), Oconto (*Goessl,*

1916), Oneida (*Goessl, 1915; Palmer, 1925*), Price, (*Goessl, 1915*), Rusk (*Goessl, 1915*), Sauk (*Palmer, 1925*), Shawano (*H. H. Smith, 1921*), Taylor (*Goessl, 1915*) and Wood (*Goessl, 1915; Davis, 1919*) Counties.

BOTRYCHIUM RAMOSUM (Roth) Aschers. Ashland (*Goessl, 1917*), Bayfield (*Cheney, 1897*), Brown (*Schuette, 1889*), Iron (*Goessl, 1917*), Marathon (*Goessl, 1915*), Polk (*Steil, 1917*) and Price (*Goessl, 1915*) Counties.

BOTRYCHIUM SIMPLEX E. Hitchcock. Marinette (*Goessl, 1916*), Oconto (*Goessl, 1910*), Sauk (*Cheney, 1893*), Sheboygan (*Ogden, 1912*), Washburn (*Goessl, 1917*) and Wood (*Goessl, 1915*) Counties.

BOTRYCHIUM TERNATUM (Thunb.) Sw., var. INTERMEDIUM D. C. Eaton. Ashland (*Lapham, 1858; Cheney, 1896*), Dane (*Hale*), Douglas (*Cheney, 1891*), Iron (*Cheney, 1896*), Marathon (*Cheney, 1893*), Marquette (*Lapham*) and Sauk (*Stout, 1906*) Counties.

BOTRYCHIUM VIRGINIANUM (L.) Sw. In woods throughout Wisconsin. Associated with *Trillium grandiflorum, Orchis spectabilis, Adiantum pedatum* and *Habenaria bracteata.*

OSMUNDACEAE

OSMUNDA CINNAMOMEA L. Common in sphagnum bogs, which are abundant in all portions of the State, except in the southwestern counties which are in the unglaciated area.

OSMUNDA CLAYTONIANA L. Common in rich mesophytic woods throughout the State.

OSMUNDA REGALIS L. Usually associated with *O. cinnamomea.*

POLYPODIACEAE

ADIANTUM PEDATUM L. Common; mesophytic woods throughout the State.

ASPIDIUM BOOTTII Tuckerm. Three Lakes, Oneida County (*Finger, 1912*).

ASPIDIUM CRISTATUM (L.) Sw. Adams (*Marshall*), Barron (*Goessl, 1917*), Bayfield (*Cheney, 1897; Goessl, 1917*), Brown (*Schuette, 1885*), Burnett (*Milwaukee Museum Expedition, 1909*), Dane (*Cheney, 1897; Milwaukee Museum Expedition, 1909*), Dunn (*Goessl, 1917*), Forest (*Goessl, 1916*), Iron (*Cheney, 1896; Goessl, 1915*), Jefferson (*Field Club, 1901*), Langlade (*Goessl, 1916*), Lincoln (*Goessl, 1915*), Marathon (*Goessl, 1915*), Marinette (*Goessl, 1916*), Milwaukee (*Lapham*), Oneida (*Palmer, 1925*), Outagamie (*Goessl, 1916*), Racine (*Davis, 1878*), Rusk (*Goessl, 1915*), Sauk (*Stout, 1906*), Taylor (*Goessl, 1915*), Washburn (*Marshall, 1916; Goessl, 1917*), Waukesha (*Wheeler, 1886*), and Waushara (*Davis, 1918*) Counties.

ASPIDIUM FRAGRANS (L.) Sw. This species has been abundant at the Dells of the Wisconsin River, where it was collected frequently (*Lapham,* 1858; *Hutchinson, 1883; Kremers, 1886; Cheney, 1894*). Fuller observed a few small plants there in 1925.

It has been collected at St. Croix Falls, Polk County; (*Lapham, 1848; Hale, 1861; Steil, 1917; Fuller and Hayward, 1923; Fassett and Wilson, 1927*).

Lapham collected a specimen of this species at Penokee, Ashland County, in 1858. In 1927, Fassett and Wilson found it growing on the wooded cliffs at Loon Lake and on bare rock on Vogt Knob, near Mellen, in the same county.

ASPIDIUM GOLDIANUM Hook. Barron (*Davis, 1923*), Calumet (*Goessl, 1916*), Marathon (*Goessl, 1915*), Milwaukee (*Lapham*), Ozaukee, (*Monroe, 1906*), Pierce (*Milwaukee Museum Expedition, 1910*), Racine (*Hale*) and Sauk (*Luse, 1877; Stout, 1906*) Counties.

ASPIDIUM MARGINALE (L.) Sw. Moist rocks in mesophytic woods; Adams (*Marshall*), Door (*Schuette, 1882; Millspaugh, 1915; Goessl, 1916*), Columbia (*H. F. Monroe, 1883*), Grant (*Sylvester, 1885; Cheney, 1895*), Iowa (*Kremers, 1888; Field Club, 1901; Heddle, 1911*), Marinette (*Goessl, 1916*) and Sauk (*Lapham, 1859; Pammel, 1880; Sylvester, 1886; True, 1887; Kremers, 1888; Cheney, 1894; Umbach, 1896*) Counties.

ASPIDIUM NOVEBORACENSE (L.) Sw. Ashland (*Lapham, 1858*), Brown (*Schuette, 1879*), Door (*Schuette, 1883*), Douglas (*Davis, 1914*), Iron (*Cheney, 1896*), La Crosse (*Pammel, 1883*), Lincoln (*Cheney, 1893*), Oneida (*Kremers, 1914*), Polk (*Baird, 1916*) and Vilas (*F. W. Johnson, 1914*) Counties.

ASPIDIUM SPINULOSUM (O. F. Müller) Sw. Common in rich mesophytic woods throughout Wisconsin, especially in the northern counties. Millions of ferns of this species are shipped from Florence and Vilas Counties each season to Milwaukee and Chicago, where they are sold as greens.

ASPIDIUM SPINULOSUM var. INTERMEDIUM (Muhl.) D. C. Eaton. Same distribution as *A. spinulosum*.

ASPIDIUM THELYPTERIS (L.) Sw. Common in moist meadows and sphagnum bogs throughout the State.

ASPLÆNIUM ACROSTICHOIDES Sw. Adams (*Sylvester, 1886; Fuller, 1925*), Dunn (*Goessl, 1917*), Grant (*Hudson, 1911*), Green (*Stuntz, 1891*), Lincoln (*Goessl, 1915*), Marathon (*Cheney, 1893*), Milwaukee (*Lapham*), Outagamie (*Goessl, 1916*), Pierce (*Allen, 1916*) and Sauk (*Cheney, 1894*) Counties.

ASPLENIUM ANGUSTIFOLIUM Michx. Brown (*Schuette, 1880*), Grant (*Hale, 1861; Milwaukee Public Museum Expedition, 1911*), Pierce (*Milwaukee Museum Expedition, 1910; Allen, 1916*), Sauk (*Palmer, 1925*) and Waukesha (*Finger, 1906*) Counties.

ASPLENIUM FILIX-FEMINA (L.) Bernh. Common in rich mesophytic woods throughout Wisconsin.

ASPLENIUM PLATYNEURON (L.) Oakes. Only two stations are known in Wisconsin where this species occurs. In 1916, Heddle collected it near Cross Plains, Dane County. In 1922, Steil collected it near Black Earth, also in Dane County. This region lies just within the edge of the driftless area where there are many limestone cliffs.

ASPLENIUM TRICHOMANES L. Shaded rocks and cliffs; Adams (*Sylvester, 1886; Cheney, 1894; Marshall; Fuller, 1925*), Columbia (*Russell*), Door (*Goessl, 1916; Millspaugh, 1918; Fuller, 1926*), Iron (*Goessl, 1917*) and Sauk (*Lapham, 1867; Pammel, 1883; Kremers, 1886; B. Harper, 1891; Stout, 1906; Palmer, 1925*) Counties.

CAMPTOSORUS RHIZOPHYLLUS (L.) Link. In Wisconsin this species seems to be limited to calcareous rock formations. For this reason it is common in the western counties and rare in the eastern counties. Brown (*Schuette, 1901*), Calumet (*Monroe, 1908*), Crawford (*Dennison, 1914*), Dane (*Cheney, 1896*), Dodge (*Chandler*), Door (*Schuette 1887; Goessl, 1916*), Fond du Lac (*University of Wisconsin*), Grant (*Sylvester, 1885; O'Hanlon, 1918; Davis, 1921*), Green (*Stuntz, 1889*), Lafayette (*Fuller, 1924*), Manitowoc (*Benke, 1910*), Milwaukee (*Runge, 1881*), Ozaukee (*Howland Russell, 1912*), Pierce (*Allen, 1916; Fuller, 1921*), Polk (*Hayward and Fuller, 1923*), Racine (*Davis, 1878*) and Sauk (*Skavlem; H. H. Smith, 1922; Palmer, 1925*) Counties.

CHEILANTHES FEEI Moore. In Wisconsin this fern is limited to the weathered limestone cliffs and bluffs in the southwestern part. In places it is very common. Buffalo (*Palmer, 1925*), Columbia (*Hutchinson, 1883*), Crawford (*Steil, 1922*), Dane (*Lapham, 1865; Heddle,*

1916), Grant (*Milwaukee Museum Expedition, 1911; Davis, 1920*), Iowa (*Kremers, 1888*), Sauk (*Hale, 1861; Monroe, 1892; H. H. Smith, 1922*) and Vernon (*Palmer, 1925*) Counties.

CRYPTOGRAMMA STELLERI (Gmel.) Prantl. Rocks; Brown (*Schuette, 1881*), Calumet (*Goessl, 1916*), Columbia (*Russell, 1886*), Door (*Schuette, 1887; Goessl, 1916*), Grant (*O'Hanlon, 1918; Davis, 1920*), Iowa (*Davis, 1921*), La Crosse, (*Pammel, 1883*), Lafayette (*Cheney, 1894*), Pierce (*Allen, 1916*), Racine (*Hoy*), Richland (*Davis, 1922*), Rock (*Olds, 1895*), Sauk (*Lapham, 1852; True, 1887; Cheney, 1891; Marshall, 1909*) and Trempeleau (*Denniston, 1914*) Counties.

CYSTOPTERIS BULBIFERA (L.) Bernh. In moist ravines and on shady calcareous cliffs. Brown (*Schuette, 1901*), Calumet (*Goessl, 1916*), Columbia (*Russell, 1886; H. H. Smith, 1922*), Dane (*Heddle, 1907*), Door (*Schuette 1889; Bruncken; Goessl, 1916*), Dunn (*Goessl, 1917*), Grant (*Milwaukee Museum Expedition, 1911; O'Hanlon, 1918*), Green (*Lapham, 1869*), Iowa (*Heddle, 1907*), Iron (*Cheney, 1896; Goessl, 1917*), La Crosse (*Pammel, 1883*), Lafayette (*H. H. Smith, 1922*), Lincoln (*Cheney, 1893*), Marinette (*Goessl, 1916*), Milwaukee (*Lapham; Kremers, 1886; Runge*), Ozaukee (*Runge*), Pierce (*Milwaukee Museum Expedition, 1910*), Rock (*Skavlem*), Racine (*Hale; Davis, 1879; Hoy, 1879*), Rock (*Olds, 1895*), Sauk (*True, 1888; Cheney, 1894; Marshall, 1916; H. H. Smith, 1922*), Sheboygan (*Swezey, 1874*), Vernon (*Milwaukee Museum Expedition, 1911; H. H. Smith, 1922*), and Waushara (*Davis, 1918*) Counties.

CYSTOPTERIS FRAGILIS (L.) Bernh. This species has a distribution similar to *C. bulbifera*.

(*To be continued*).

Lake Rotoiti

H. B. DOBBIE

The road from Tauranga to Te Puke was very hilly and rough and kept in bad repair. High forest ranges appeared on the right and much flat, swampy land on the left, between the road and the sea. After that it improved greatly as, for fifteen miles, we penetrated the most terrible looking country, a jumble of steep ridges and deep narrow gullies, all the more dreary looking as it was quite bare of forest and covered with a rusty growth of bracken. Glancing across at the neighboring mountain ridges similar to that on which our road had been made it seemed inconceivable to me that any men should have had the courage to make a road through such a country. Yet we spun along over a surface like a billiard table—of course at this season the road was at its best—round easy curves, and gradients not too steep. The country looked as rugged as the surface of the moon! There were no houses, cattle, sheep or living beings. In forty miles we met only one motor car, but I am told that deer are occasionally seen. It seemed to me that the only use to which such land can be put is afforestation—there must be thousands and thousands of acres. I never enjoyed a ride so much, sitting at my ease as we spun along a narrow ridge, the ground to the right dropping nearly perpendicularly to a narrow gorge several hundred feet below, then an easy twist of the admirable road, and we shot past a profound gulf on the left. I must compliment the engineers and the county council responsible for the making and upkeep of this road.

In the afternoon we sighted Lake Rotoiti, a lovely sheet of water ten miles long and shut in by steep forest-clad mountains. We skirted round for twenty miles.

passing that abomination of desolation, Tikitere, smelling foully of sulphur, an arid white scar on the beautiful green land, with its mud volcanoes, clouds of steam and pools of stagnant water. The latter part of the journey was very beautiful, the road having been cut across the face of jagged cliffs that descended to the water's edge, every crevice and fissure supporting a vigorous growth of tutu and konini bushes, small trees, palmleaf ferns, bracken, etc.

We stopped at a store to lay in a stock of provisions and had to await the leisurely attendance of a stately Maori damsel who also looked after the post office, telephone, telegraph, fishing licenses and the Lord knows how many other duties. After an interminable delay for vegetables one of the party brought in the encouraging intelligence that he had seen her sowing the carrot seed! But they were very confiding at this store, handing over to us a bill form with the request that we would fill it in and add up the total.

Hongi's track is very beautiful, majestic trees, against which the car almost brushes, towering up on each side of the road, which is made only wide enough for two motor cars to pass. There are very fine specimens of the wheki ponga (*Dicksonia fibrosa*) with its graceful plumed head; also the other three tree ferns, mamaku, wheki and ponga. I counted forty species of herbaceous ferns, including the beautiful New Zealand Davallia, but the filmy ferns were confined to three out of our twenty-one species. On the next day my daughter and I went for a seven-mile ride into the forest, perched on a locomotive tender piled up with firewood. It was very pleasant going out into the forest as the engine ran tender first, like an observation car without windows. The line, three feet six inch gauge, was well laid, sometimes up one in fifteen inclines and round amazingly sharp curves.

The engine, upright like a marine engine, with mitred gearing to the bogie axles, worked somewhat ponderously, but it negotiated difficulties an ordinary locomotive would not have looked at.

The felling, rimu, matai, and white pine, is nearly all done by Maori workmen, who are very clever with axe and saw. There are hauling engines in the forest which drag the logs with long wire cables on to the loading stages. The timber is delivered at the eastern end of Rotoiti, loaded on to a punt and towed ten miles across the lake to the saw mill. Mr. Wackrow and his employees were all most obliging and did everything to make our journey a pleasant one. I saw nothing very interesting in the fern line except a vigorous type of *Asplenium bulbiferum*, very open dark green fronds with black undersides to the stems and midribs.

In the afternoon we crossed the lake in a row boat. The mountains, covered with virgin forest, descended very steeply to the water's edge; the rocks, though perpendicular, in many places were covered with vegetation. Gazing up at the virgin forest covering the side of Mount Matawhaura, nearly 2,000 feet high and 1,000 feet above the lake, one could trace the course of a stream by a line of tall tree ferns. I am glad to say this forest is reserved, but the hills are so precipitous that they practically reserve themselves, which is fortunate, as much of the adjacent bush is being damaged by fallow deer. Why any one should introduce animals whose flesh is much inferior to beef or mutton passes my comprehension.

Here I was more fortunate with the ferns, adding the following to my collection round Rotoiti: *Asplenium Hookerianum* and var. *Colensoi*, *Trichomanes humile*, *elongatum* and *strictum*, *Polypodium australe*, and *Lindsaya Lessoni*. Next day we motored ten miles to Lake

Okataina. The road wound among forest-clad mountains. The quantity of ferns is incredible and cannot be conceived by those who have not seen them; they brush the sides of the car as you go by, the dense vegetation arching overhead until you travel in a subdued twilight most gratifying on a hot summer day.

Leaving my daughter and her husband to fish in the lake, I wandered back along this delightful road, adding four more ferns to my list, and making one of the discoveries of my life—*Botrychium ternatum* var. *dissectum*. It was on the ground, growing among a carpet of filmy ferns, a pure accident that such a blind bat as myself should have found it. I also got *Lomaria vulcanica*, for which I have been searching—the furthest north I have seen it.

I narrowly missed this find (*dissectum*). I had disobeyed orders to be at the lake punctually at 1 o'clock; but I could not resist the ferns and dawdled on, making short excursions into the bush on each side of the road. Five minutes after making my great discovery I heard the car tooting impatiently for me. Fortunately my daughter had walked up some of the side tracks in search of her truant father which delayed this arrival. I was so elated with my find that the scolding I got did not penetrate very deep. No one is so utterly selfish as the enthusiast, but, by way of expiation, I washed and put away all the tea things that evening while my daughter and her husband went out fishing.

To turn to another subject, I have invented a patent staircase by which, no doubt, some brainy architect will make a fortune. Our shack is on a shelf about sixteen feet above the lake. The soil, a soft pumice and volcanic ash, can be cut with a spade, like cheese. The water from the lake has to be carried up a steep incline; my job was to cut steps; there are about twenty. Learning

by experience that the upper steps were much harder to negotiate with a heavy load than the lower ones, I made the "lift" shallower and shallower as I went up. Thus, say the bottom step has a rise of twelve inches, I reduced each as I ascended by one-fourth inch until the top one had only an eight-inch rise. Thus, in an ordinary house staircase, the rise of the bottom step would be seven inches, and, decreasing each by one-eighth of an inch, the top step would have a rise of only five inches.

There are a good many Maoris at Rotoiti. Each day a charabanc passes piled up with school children—the government aid to native education. The children have been spoiled by tourists and are incorrigible beggars, but they were not long in finding out that we were a barren patch, and now leave us alone. On the first day a small boy volunteered his services as a guide into the bush—that is to say, I walked in front and he followed me. He suggested a douceur of "five bob," and when I laughed at once dropped to sixpence. I gave him twopence, which was exactly twopence more than he had earned in his half-hour stroll. The Maori ladies, like other daughters of Eve the world over, are slaves to fashion. A lady tourist living near the lake adopted "shorts" as the most convenient dress for the rough life of camping. The Maoris, thinking this the latest Paris fashion, at once "pinched" their husbands' pants and looked shyly pleased when I commented on their appearance.

AUCKLAND, NEW ZEALAND

The Habitat and Distribution of the Broad-leaf Spinulose Ferns

EDWARD H. CLARKSON

During the past five years the writer has had growing in his fern garden more than one hundred roots of the broad-leaf spinulose ferns, *Dryopteris dilatata* (Hoffm.) Gray and *Dryopteris dilatata* var. *americana* (Fisch.) Benedict. These plants came from various places considerable distances apart, as follows. Roots of *D. dilatata* were imported, under a special permit from the United States Government, from the estate of Mr. Alexander Cowan, Valleyfield, Penicuik, Midlothian, Scotland, where thousands of this beautiful fern grow luxuriantly at an altitude of about six hundred feet above sea level. Other plants of *D. dilatata* came from Mr. J. B. Flett, Seattle, Washington, where this fern grows plentifully at altitudes near sea-level and upward.

The roots of var. *americana* were from various places in Maine, New Hampshire, and Massachusetts.

DISTRIBUTION AND HABITAT OF VAR. AMERICANA

Var. *americana* is found in the cold Canadian forest regions of eastern and northeastern North America from North Carolina to Labrador and Greenland. It seldom grows very much below or outside of these forest regions, and is occasionally found above the timber-line. In North Carolina it grows at an altitude of 4500 feet and even higher. As we follow north, we find it growing at lower and lower level until in southeastern Maine and northward it is found at sea-level.

The writer desires to call attention to a statement made in an article entitled "Problems in the Study of the Spinulose Ferns," by Dr. R. C. Benedict, AMER. FERN JOURN. Vol. 14, no. 3, 1924. "*Dilatata* is only one of an association of plants found regularly under alpine

conditions from the Alleghanies northward."[1] This statement seems to the writer to be misleading.

"*Alpine,*" to most botanists, applies to such species as *Rhododendron lapponicum, Silene acaulis,* and such other plants as are really confined to the area above timber-line, or nearly so. Var. *americana,* even though it occasionally occurs above timber-line (so does the lady fern, for that matter) is mainly a plant of the Canadian forest region. Where that forest is high, as in much of New England and the Adirondacks, var. *americana* is high; where, as in southeastern Maine, the forest comes down to sea-level, var. *americana* comes down also.

DISTRIBUTION OF D. DILATATA (LASTREA DILATATA)

"*Lastrea dilatata* is a common and generally dispersed European species, occurring from Lapland and Norway to Portugal and Spain, the Savoy Alps, Italy, Croatia, and Transylvania. In Asia it occurs in Kamchatka, near Petropaulowski, and in Mingrelia: in Africa, in the Azores and in Bourbon. In America it occurs at Sitka and at Kodiak in Russian territory: at Port Mulgrave and in the Rocky Mountains: in New England[2] and Canada. There is also in the Hooker Herbarium, a specimen labelled New Zealand." From Thomas Moore's "Nature-printed British Ferns" (Vol. 2), London, 1863.

The writer desires to add the following. Examination of the specimens of *D. dilatata* in the United States National Herbarium indicates that this fern is widely distributed in southern Alaska. It is also found plentifully in western Canada and especially in British Columbia. In the United States it is found in Montana and Washington and south to California.

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[1] "*Dilatata*" is here taken as including var. *americana;* so far as the region "from the Alleghanies northward" is concerned, the latter is meant.

[2] This refers to var. *americana.*

HABITAT OF D. DILATATA

Because of the following statement from the pen of Dr. R. C. Benedict the writer has taken considerable pains to secure accurate and conclusive evidence regarding the habitat of *D. dilatata* both in Europe and in northwestern North America.

The Statement. "*Dilatata* and var. *americana* are alpine or arctic forms, i. e., they require a cold climate. In Labrador and Greenland it is cold enough at sea level, but further south in Europe and in America, *dilatata* finds suitable coolness only on mountains." From "Fern Papers in Rhodora" (review), AM. FERN JOURN. Apr.–June, 1916.

The Evidence. Mr. Alexander Cowan, of Valleyfield, Penicuik, Midlothian, Scotland, wrote as follows:— "*Lastrea dilatata* grows in Scotland *at all altitudes.* I have thousands of it growing on my land here, six hundred feet altitude."

The following letter from Dr. Christensen proves that this fern grows plentifully in Denmark and throughout the great German Plain. The altitude of nearly the whole of these two areas is five hundred feet or less.

Universitetets botaniske Museum
Gothersgade 130. Kobenhavn K
10 Januar, 1927

MR. EDWARD H. CLARKSON,
NEWBURYPORT.

Dear Sir:—

As to the distribution of *D. dilatata* in N. Europe I can say the following. It is in woods in Denmark a common species, also occurring frequently in bogs, but there in a special form with recurved edges and *black* spores. It is here certainly more common than *D. spinulosa.* Denmark being a part of the Baltic or North German Plain it is no wonder, therefore, that *D. dilatata* is common in the whole area just as in Denmark, the sandy heaths, of course, excepted. In P. Ascherson u. P. Graebner: Flora des

Nordostdeutschen Flachlandes, 1898, p. 9 (the area just mentioned by you), we learn of the collective species *Aspidium spinulosum*: "Schattige und lichte Wälder und Gebüsche, durch das Gebiet meist *gemein*" (shady and open woods and thickets, common in most parts of our area) and on the subspecies *A. dilatatum* "so weniger häufig (als *eu-spinulosum*), gern an schattigen Abhängen" (somewhat less common than *eu-spinulosum*, preferring shaded hillsides.)

It is certainly common in all woods and naming localities is of no importance.

Yours truly,

[Signed] CARL CHRISTENSEN

Dr. Christensen also wrote as follows: "I note that we in Denmark have no mountains, the most elevated hill being 170 m. only" (less than 600 feet.)

Professor Frederic K. Butters, who has given considerable attention to the study of *Dryopteris dilatata* in northwestern America, wrote as follows:— "It is common from sea-level up to four thousand to five thousand feet. I have seen and collected it at sea-level at Vancouver Island and also around Glacier, B. C., in the Selkirk Mountains, where it is very abundant at altitudes of over four thousand feet. Timber line is about seven thousand feet and, so far as I recollect, *dilatata* never gets anywhere near that altitude."

Mr. Paul C. Standley, in an article entitled "Ferns of Glacier National Pork" (Montana), AM. FERN. JOURN. Oct.–Dec., 1920, reported *Dryopteris dilatata* on the mountains there at an altitude of 3170 feet on the west and 4800 feet on the east slope and further speaks of it as common at *middle altitudes*, especially on the west slope.

Mrs. Carlotta C. Hall, of Berkeley, California, writes "It is wonderfully fine in the Redwoods, where it is very damp, at about 50 to 100 feet altitude." Mr. J. B. Flett, of Seattle, Washington, who has an expert knowl-

edge of this fern, having studied it for many years, writes that "it is quite common in rich woods near sea-level, not extending very high in the mountains."

The above evidence, which is furnished by well known fern experts, proves conclusively that *Dryopteris dilatata* does *not* require a cold climate. On the contrary, it proves that in the British Isles, in Denmark and in the vast North German Plain, as well as in British Columbia and the State of Washington, this fern is found plentifully at sea-level, as well as in the mountains. These places are regions of relatively warm winters and cool summers. Like our *D. intermedia,* it flourishes in warm as well as cool temperatures.

The writer could find no evidence that *D. dilatata* is found above timber-line.

NEWBURYPORT, MASS.

Recent Fern Literature

It is not often that the JOURNAL uses reprinted matter; but the article which follows, by a recent member of the Society, gives so excellent a history of the beginnings of an enthusiasm for ferns, so admirably put (as well as an account of a new and interesting fern book by another member), that we would break a rule or two, if necessary, to place it before our readers. For the privilege of doing so, we are indebted to the kindness of the author and the courtesy of the *Providence Journal,* in whose columns it originally appeared, June 9, 1928.

CONCERNING FERNS

FIELD BOOK OF COMMON FERNS. By Herbert Durand. New York: G. P. Putnam's Sons. 16mo. Illst. $2.50.

It is remarkable how many different ways there are of getting your hands dirty in this complex world. Babies

are born with the faculty; the growing child (that arch-anarchist) devotes his tender years to elaborating his primitive knowledge of the art. Yet the sober adult, safely graduated from all these early foibles, is steadily surprised to find himself ever and again grubbing in the earth for something or other which, only lately, he would never have supposed himself to need.

With clean hands and an unsuspecting heart I tumbled into the mud a week ago Sunday, and I don't know when I shall crawl out of it again. Ferns lie at the bottom of the matter. As recently as Memorial Day a fern, to me, was only a fern—a sort of plant without blossoms which grew, probably, in the woods, and was best left to its lovely peace. If we hadn't been cheated by the man who sold us the daffodil bulbs it would never have happened. But the bulbs didn't germinate, if that's what I mean; their allotted space in the dooryard garden stood bleak and forlorn, a reproach to husbandry. "Perhaps," suggested that member of our household who achieves by garden magic more than the rest of us can accomplish badly with hard labor, "perhaps a few ferns."

Ferns grow in woods and swamps, among the black rot of old leaves or upon the hillside shale where the weather's rejected artifacts rebuff the amateur with ten thousand needle points—barbs that have waited since the tertiary midnight to prick your own personal shins, and no other shins. Ferns grow, in short, where man does not; and the road to them is like the road to paradise. But we got ferns—forty of them, in eleven notable varieties. Roots and all, we planted them over the defeated daffodil stumps, to console us with their feathery excellence for the lost golden chalices. And that was that.

But life doesn't chop things up into such neat parcels. You can't whip up an enthusiasm, use it for an afternoon, and then throw it away. In the morning, it walks in upon you, like one of those stray cats which each of us, in some mad moment, has stopped to pet. It yowls from the bedside. It curls up on your feet. It has come to stay. We went to sleep with a job finished; we arose with a complex and fascinating obligation upon us. These woodside aliens, it seemed, were individuals, each with a name, each with its needs and caprices, each with the temperament of a prima donna.

It is extraordinary how much there is to be known about a subject which yesterday was a mystery. Goldsmith thought a folio volume could be written about an egg (time has proved him more than right!) and Johnson replied that even the making of bootjacks breeds experts. I can see now that if I resign all other obligations and remain on my knees in that fern-patch until Atropos snips her scissors across my particular thread, I shall still have something to learn about spores and spore-cases, fronds and pinnules, the way of spleenworts and the different way of brakes.

Now by one of those incredible coincidences, such as the old yarn-spinners employed when they had to snatch their heroines out of the clutches of villainy, I was still scrubbing my hands with pumice to wear off the root stains when the postman rang and handed me in the little book—the amazing little book—listed at the top of this column. Nobody outside our garden wall knew about those ferns; the book was mailed in New York ten hours before we set forth to dig in the woods! Is it any wonder that cabinet secrets leak out and that wars are started for no reason at all?

Well, it is an inimitable book, if you are going in for ferns. Fifty native varieties are named, pictured, diagrammed, discussed. You are told what to plant and

what to avoid, what to dig in the open woods and what to buy.

"Do not," it says, "plant the hayscented fern, the bracken or the marshfern, for they will eat up the rest of the works." Or something of the sort.

We had, of course, planted hayscented ferns, many bracken, very many marshfern.

"You will be fortunate if you find a Christmas fern in the vicinity of a large city," the books say. "Vandals have destroyed them."

The pride of our new garden, by a small miracle, was a magnificent Christmas fern, for which we had not even hunted!

And so on. The barren garden plot had begun it; the book had sealed the deed. Bring on your experts. I shall gabble to them about pinnate and bipinnate fronds, I shall point them the distinction between thelypteris clintoniana and thelypteris spinulosa; I shall show them osmundae and botrychia of the loveliest hues. Grasping them by their buttonholes, I shall remind them that there were ferns on this earth 53 million years ago, that there may be ferns on Mars, that Adam slept among them. I shall dilate upon the connection between ferns and furnaces—for what is coal but the pressed bracken of a thousand ages? I shall, in short, bore them to tears, for the fever is upon me.

Go thou, if you love a garden, and do likewise. But arm yourself first with this little book. It is a mighty Baedeker for a strange and astonishing kingdom—a land of living lace.—BERTRAND K. HART.

Mr. Mousley[1] continues his annual notes on the birds, orchids, ferns, and butterflies of Quebec. Ferns play a

[1] Mousley, H. Notes on the birds, orchids, ferns, and butterflies of the province of Quebec, 1927. Canadian Field Naturalist 42: 25–29. 1928.

fairly prominent part in those for 1927. Certain interesting species are recorded from the vicinity of Montreal; *Botrychium minganense*, recently described by Bro. Victorin, was found to have been collected at Hatley several years ago, and a new station for *B. onondagense* discovered there; and at Chambly, after years of searching, Mr. Mousley had his first sight of *B. angustisegmentum* alive and in its native habitat. Other records for some of the rarer species are given.

QUESTIONS.—Apropos of the fact that Mr. H. A. Ward of the Harrisburg Natural History Society has found one lone specimen of Eaton's fern on one of the mountains back of the city, the question arises, how came it there?

A very small woods garden at Mount Gretna is the subject of much study and speculation. Years ago, when it was acquired, there was dense shade of chestnut growth. Later these trees were felled because of blight and other smaller trees were brought in together with many ferns and other woodsy things.

Grass began to appear and violets and flowers hitherto unknown to the gardener, so that each year we would be greeted by new things. One year there appeared a thrifty plant and flower of *Centaurea*. Another year there came the cone flower. This year there is the mountain phlox.

When I ask whence come these visitors, I am told, rather glibly, it seems to me, "O, well, when you bring in plants from the woods, you bring seeds of other plants." This answer does not satisfy.

To return to the Eaton's fern:—are these rare things beginning their existence because of certain conditions of earth, air, sunlight, and moisture, or are they passing

out from us and on their way to extinction?—SARA P. BILL, HARRISBURG, PA.

It is not easy to give a general answer to Mrs. Bill's questions, for they touch on one of the mysteries of nature—the exact manner in which plants effect their migrations. Many species, of course, have special mechanism for the dispersal of their seeds, the workings of which we can follow. But others, with no such mechanism (most of the grasses, for instance), have spread over and occupied their full share of the earth's surface.

We can only say that seeds are actually widely distributed and in great numbers and that many of them are very long-lived. Two Japanese botanists have recently grown lotus seeds known to be a century old and and got rather better germination than from fresh seed. In any given spot, the soil may contain seeds or spores of the most unexpected things, which may lie dormant for years and then, when conditions are right for germination, suddenly appear.

Only a study of local conditions can throw any light on the question of whether the single specimen of Eaton's fern was a new comer, born of windblown spores, or the survivor of a previously over-looked colony. The *Centaurea* and the cone flower are both aggressive weeds of open places and found their opportunity when the shade was reduced by the cutting off of the chestnut trees. Certainly many plants can be inadvertently brought in with other plants moved to a garden. I have in my fern-bed a little colony of wild things, comprising pepper-root, spring beauty, partridge berry, gold-thread, star-flower, *Aster divaricatus*, jewel-weed, bellwort, and hog peanut, none of which I knowingly introduced. I did plant ferns from the woods and bits of the roots or seeds of the other plants came with them. Except with the

jewel-weed, no other method of introduction is conceivable in this case.—C. A. W.

UNDER WHAT CONDITIONS DOES DRYOPTERIS DILATATA GROW?—I am glad Mr. Clarkson has returned to the discussion of the *Dryopteris dilatata* problem, even though the result in part is to indicate that I have been inaccurate in using the terms "alpine or sub-arctic" when I should have used the ecological term "Canadian forest" as characterizing the habitat of *dilatata*. Also, instead of the term "cold regions," it would be more accurate to describe the climatic condition as "cool and damp." With these corrections, I should like again to raise the question whether *dilatata* is not practically confined to regions in which moisture is generally abundant in the atmosphere. Such conditions are found at low altitudes in England, in Denmark, in our Pacific states north of San Francisco, and also along the North Atlantic coastal regions. Inland, however, and farther south, *dilatata* usually finds favorable conditions only at considerable altitudes where clouds and fog supply the needed atmospheric moisture.

In Mr. Clarkson's discussion regarding the European distribution of this fern, I note as of pertinence in this connection that the Moore quotation mentions the "Savoy Alps," though not otherwise informative regarding the distribution in altitude. In an earlier paper I have already referred to correspondence from a South German fern student to the effect that *dilatata* is in his region confined to higher altitudes, with *spinulosa* the species occurring at lower ranges. It seems to me that we still need discriminating comment regarding the distribution of *dilatata* ecologically in Europe. To consider the geographic ranges alone is likely to be misleading.—R. C. B.

PROGRAM FOR THE MEETING OF THE FERN SOCIETY AT NEW YORK.—The formal meeting will take place at the Teachers' College Building, Columbia University, at 2 P. M. on Saturday, December 29th. Room assignments have not been made yet, but will be available at the entrance of the building on East 119th Street. Teachers' College is the headquarters for most of the meetings of the 1928 Convocation of the American Association for the Advancement of Science, which begin on Thursday, December 23rd.

Our Fern Society program will include the following papers: Prof. John H. Schaffner, Diagnostic Characters of Equisetum; Dr. Edgar T. Wherry, Soil Reaction Preferences of Native Ferns; Prof. Fr. Marie-Victorin, About a new American Botrychium; Mr. C. A. Weatherby, Recent Systematic work on northeastern Ferns. Rev. Charles S. Lewis and Dr. William R. Maxon will also have papers, the exact titles of which are not at hand as this goes to press. Most of the above papers will be illustrated by specimens; Dr. Wherry's will be illustrated experimentally. Space and time are reserved for any others to display interesting specimens or report experiences.

Ten years ago, in connection with the last Fern Society meeting in New York City, a group of members went searching for fern material in the diversified menu of a Chinatown restaurant. Some were timorous about the adventure at first, but nothing untoward happened. If those who attend this year's meeting would like to make a similar exploration, an opportunity will be afforded. A choice may be made among Chinese, Japanese, Russian, Syrian, East Indian, Italian, French, et al.

On Sunday afternoon, at two-thirty, a meeting is scheduled at the Brooklyn Botanic Garden to visit this Fern Society headquarters. The living ferns in the greenhouse will be the particular object of the visit, both

the general tropical collection and the series of Boston fern sports which are being grown experimentally. Dr. Benedict will act as host and guide.

REV. CHARLES S. LEWIS, DR. MARSHALL A. HOWE, FREDERIC W. KOBBÉ, DR. RALPH C. BENEDICT, *Committee on Program.*

American Fern Society

It is with pleasure that we print in this number the beginning of one more of the series of state fern floras which, under the encouragement of the Society, have appeared from time to time in the *Fern Bulletin* and the JOURNAL. The *Bulletin* published eighteen of them, covering the states of California, Connecticut, Florida, Georgia, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maine, Michigan, Montana, New York, Ohio, Pennsylvania, Texas, Vermont, and Washington. To these the JOURNAL has added Alabama, Nebraska, New Mexico, a nearly complete enumeration of New Jersey ferns, and now Wisconsin. The full list is given so that members who may be in a position to write up the ferns of any of the other twenty-six states may have their opportunity put plainly before them.

Mr. Harold G. Rugg, Hanover, N. H., offers to members fronds of *Botrychium Lunaria*, collected at Percé, Gaspé Co., Quebec.

New members:

Davis, Edward E., Norwich, N. Y.

Doubleday, Mrs. Arthur W., Longhill, Woodstock, Vermont.

Payne, Prof. Clarke B., Chimopovy, Arizona.

Stephens, George E., 36 Bedford Road, Horsham, Sussex, England.

Changes of address:

Clute, Prof. Willard N., Butler University, Indianapolis, Indiana.

Gilmore, Mrs. Edward L., 125 South Whitney Ave., Youngstown, Ohio.

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ERRATA

Page 75, line 4. For integrading read intergrading.

Page 93, line 3. For GOLDIANUM × MARGINALE read GOLDIANUM × SPINULOSUM var. INTERMEDIUM.

Page 94, line 29. For *gaspensis*, read *gaspense*.

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EDITORS

R. C. BENEDICT

E. J. WINSLOW C. A. WEATHERBY

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American Fern Journal

VOL. 19 JANUARY–MARCH, 1929 NO. 1

Ferns and Fern Allies in Wisconsin--II

DR. W. N. STEIL,
Professor of Botany, Marquette University

AND

A. M. FULLER
Assistant Curator, Milwaukee Public Museum

DICKSONIA PUNCTILOBULA (Michx.) Gray. Collected by Dr. Millspaugh at Ephraim, Door County, in 1918.

ONOCLEA SENSIBILIS L. Moist woods and meadows throughout the State.

ONOCLEA STRUTHIOPTERIS (L.) Hoffm. In moist woods and along river bottoms throughout Wisconsin. This species is not as frequent as *O. sensibilis.*

PELLAEA ATROPURPUREA (L.) Link var. BUSHII Mackenzie (*P. glabella* Mett.). On calcareous rocks; common in the southern and western counties where it is often associated with *Cheilanthes feei.* Adams (*Marshall, 1909*), Brown (*Schuette, 1901*), Buffalo (*Benke, 1915; H. H. Smith, 1922*), Calumet (*Goessl, 1916*), Columbia (*Hutchinson, 1883; Russell, 1886; Davis, 1918; H. H. Smith, 1922*), Crawford (*H. H. Smith, 1922*), Dane (*Heddle, 1920*), Door (*Schuette, 1882; Goessl, 1916; Davis, 1918*), Grant (*Sylvester, 1885; Cheney, 1889; Milwaukee Museum Expedition, 1911; O'Hanlon, 1919; Davis, 1920*), Green, (*Stuntz, 1891*), Iowa (*Steil, 1924*),

[Volume 18, No. 4 of the JOURNAL, pages 105–136, figures 9 and 10, was issued December 4, 1928.]

Lafayette (*H. H. Smith, 1922*), Milwaukee (*Runge*), Pierce (*Milwaukee Museum Expedition, 1910; Davis, 1914*), Polk (*Hayward, 1923*), Richland (*Davis, 1922*), Rock (*Kumlien, 1860; Olds, 1895*), Sauk (*Hale, 1861; True, 1886; Kremers, 1888; Cheney, 1894; H. H. Smith, 1922*), Trempeleau (*Denniston, 1914*) and Vernon (*Milwaukee Museum Expedition, 1911*) Counties.

PHEGOPTERIS DRYOPTERIS (L.) Fée. Shady rocks, moist woods and sphagnum bogs; Adams (*Sylvester, 1886; Marshall; Fuller, 1925*), Ashland (*Cheney, 1896: Goessl, 1917*), Barron (*Goessl, 1917*), Bayfield (*Cheney, 1897*), Burnett (*Milwaukee Museum Expedition, 1909*), Chippewa (*Goessl, 1915*), Columbia (*H. F. Monroe, 1883*), Dane (*Field Club, 1901*), Door (*Schuette, 1883*), Douglas (*Goessl, 1917*), Florence (*Goessl, 1916*), Iron (*Goessl, 1917*), Juneau (*Davis, 1917*), Kewaunee (*Goessl, 1916*), Langlade (*Goessl, 1916*), Lincoln (*Goessl, 1915*), Marinette (*Goessl, 1916*), Oneida (*Kremers, 1914; Goessl, 1915*), Outagamie (*Goessl, 1916*), Price (*Goessl, 1915*), Racine (*Hoy, 1879*), Rusk (*Goessl, 1915*), Sauk (*Pammel, 1883; True, 1887; Heddle, 1907*), Sawyer (*Fuller, 1925*), Shawano (*Goessl, 1916*) and Vilas (*Denniston, 1901*) Counties.

POLYPODIUM VULGARE L. Common in moist rocky woods throughout Wisconsin; Adams (*Marshall; Fuller, 1925*), Ashland (*Cheney, 1896*), Bayfield (*Cheney, 1897*), Calumet (*Goessl, 1916*), Chippewa (*Goessl, 1915*), Clark (*Goessl, 1915*), Columbia (*Hutchinson, 1883; Russell*), Dane (*Lapham, 1860; Williamson, 1886; Field Club, 1901; Cheney and True, 1892; University of Wisconsin, 1892*), Door (*Schuette, 1896; Goessl, 1916; Millspaugh, 1918*), Dunn (*Goessl, 1917*), Forest (*Goessl, 1916*), Grant (*H. H. Smith, 1922*), Iowa (*Steil 1922*), Iron (*Cheney, 1896; Hartwell, 1913; Goessl, 1917*), Juneau (*Cheney, 1894*), Lafayette (*Cheney, 1889; Ful-*

ler, 1924), Lincoln (*Cheney, 1893; Goessl, 1915*), Manitowoc (*Benke, 1910*), Marinette (*Peaslee, 1914; Goessl, 1916*), Milwaukee (*Lapham*), Oneida (*Kremers, 1914; Goessl, 1915*), Ozaukee (*Howland Russel, 1912*), Pepin (*Goessl, 1917*), Pierce (*F. W. Fuller, 1921*), Polk (*Schuette, 1888; Campbell, 1896; Hayward, 1923*), Price (*Goessl, 1916*), Racine (*Davis, 1878*), Rock (*Swezey*), Sauk (*Lapham, 1849; Pammel, 1883; Kremers, 1886; True, 1887; Cheney, 1889; Umbach, 1895; Skavlem; H. H. Smith, 1922*), Sawyer (*Fuller, 1925*) and Taylor (*Goessl, 1915*) Counties.

POLYSTICHUM ACROSTICHOIDES (Michx.) Schott. At the University of Wisconsin there are three herbarium mounts of this fern; Racine County (*Hale; Mrs. Atwater, 1866*), and from an unknown locality collected by Dunlap, 1893.

POLYSTICHUM BRAUNII (Spenner) Fée. Cheney collected this fern along the Montreal River in Iron County, in 1896. The specimens are deposited in the herbarium at the University of Wisconsin.

PTERIS AQUILINA L. Dry open woods; common throughout Wisconsin. This fern is one of the dominant plants growing on the cut-over land in the northern counties where it is usually associated with *Populus tremuloides* and *Epilobium angustifolium*.

WOODSIA CATHCARTIANA Robinson. Steil collected this fern at St. Croix Falls, Polk County, in 1917. In 1927, Fassett and Wilson also collected it there.

WOODSIA ILVENSIS (L.) R. Br. Adams (*Sylvester, 1886; Monroe, 1892; Marshall*), Bayfield (*Hasse, 1884; Cheney, 1896*), Clark (*Goessl, 1915*), Dane (*University of Wisconsin, 1860; Williamson, 1886; Field Club, 1901; Cheney, 1894; Heddle, 1916; Davis, 1921*), Grant (*Sylvester, 1886*), Green (*Finger, 1902*), Iowa (*Kremers, 1888; Heddle, 1920; Davis, 1921*), Juneau (*Copeland;*

Fuller, 1927), Lincoln (*Cheney, 1893*), Marathon (*Goessl, 1915*), Marinette (*Goessl, 1916*), Polk (*Schuette, 1888; Davis, 1914; Fuller, 1922*), Rock (*Olds, 1895*), Sauk (*Lapham, 1858; Pammel, 1883; Umbach, 1888; Monroe, 1892; Cheney, 1894; Stout, 1906; Skavlem; True*) and Waupaca (*Goessl, 1916*) Counties.

WOODSIA OBTUSA (Spreng.) Torr. Columbia (*Hutchinson, 1883; Finger, 1904*), Grant (*Sylvester, 1886*), Green (*Copeland, 1891*), Iowa (*Davis, 1921*), and Sauk (*Lapham, 1858; True, 1893; Stout, 1906*) Counties.

SALVINIACEAE

AZOLLA CAROLINIANA Willd. In Wisconsin this species is confined to the Mississippi River and the adjoining sloughs. In the summer of 1912, Mrs. Irish observed that it was abundant in the Mississippi River at La Crosse. In the autumn of 1920, Steil found it abundant in the sloughs and in the Mississippi near Prairie du Chien. Fassett collected it in Buffalo County in 1926. In the herbarium at the University of Wisconsin there are three sheets, evidently from the Lapham collection. Two of these were collected along the Mississippi in 1872 by an unknown collector. The other sheet is labeled "Black Earth, Dane County." Neither the date nor the collector is given.

EQUISETACEAE

EQUISETUM ARVENSE L. Common throughout the State. It is found in old sandy fields, on river banks and along the rights of way of the railroads.

EQUISETUM FLUVIATILE L. Common at margins of lakes, in ponds and bogs; Bayfield (*Cheney, 1897*), Brown (*Schuette, 1886*), Buffalo (*H. H. Smith, 1922*), Calumet (*Goessl, 1916*), Dane (*Hale; Cheney, 1891; University of Wisconsin, 1892; Field Club, 1901; Stout,*

1907), Door (*Goessl, 1916*), Douglas (*Milwaukee Museum Expedition, 1909; Goessl, 1917*), Florence (*Goessl, 1916*), Jefferson (*Stout, 1906*), Marathon (*Goessl, 1915*), Marinette (*Goessl, 1916*), Milwaukee (*Lapham; Bruhin; Runge, 1886*), Oconto (*Davis, 1915*), Outagamie (*Goessl, 1916*), Price (*Graenicher, 1915*), Rock (*Olds, 1895*), Vilas (*Cheney, 1893; Milwaukee Museum Expedition, 1907*), Washington (*Wheeler, 1888*), *Waukesha* (*Howland Russel, 1915*), and Waupaca (*Goessl, 1915*) Counties.

EQUISETUM HYEMALE L. Common throughout Wisconsin. This species is found in a habitat similar to that of *E. arvense.*

EQUISETUM HYEMALE var. ROBUSTUM (A. Br.) A. A. Eaton. Bayfield (*Cheney, 1896*), Brown (*Schuette,* 1898), Dane (*Cheney, 1890*), Door (*Schuette, 1885*), Grant (*O'Hanlon, 1919*), Iron (*Cheney, 1896*), and Sauk (*Field Club, 1901*) Counties.

EQUISETUM LAEVIGATUM A. Br. (*E. kansanum* Schaffn.) Brown (*Schuette, 1898*), Dane (*University of Wisconsin, 1892; Davis and McFarland, 1921*), Door (*Schuette, 1887*), Rock (*Olds, 1895*) and Sheboygan (*Schuette, 1883*) Counties.

EQUISETUM PALUSTRE L. Cheney collected this species at Siskiwit Bay, Bayfield County, 1897, and along the Ammicon River, Douglas County, 1897.

EQUISETUM SCIRPOIDES Michx. Moist woods and low open places. Ashland (*Cheney, 1896; Goessl, 1917*), Bayfield (*Cheney, 1897*), Door (*Schuette, 1887; Howland Russell, 1913; Goessl, 1916*), Douglas (*Allen, 1915*), Dunn (*Goessl, 1917*), Grant (*Sylvester, 1885*), Kewaunee (*Goessl, 1916*), Manitowoc (*Benke, 1910*), Milwaukee (*Lapham*), Outagamie (*Goessl, 1916*), Rusk (*Goessl, 1914*), Shawano (*Goessl, 1916*), Sheboygan (*Goessl, 1902*) and Winnebago (*Sherman*) Counties.

EQUISETUM SYLVATICUM L. Moist, shady woods; abundant in the northern counties. Ashland (*Lapham, 1885; Cheney, 1896; Goessl, 1917*), Barron (*Cheney, 1888; Goessl, 1917*), Bayfield (*Cheney, 1897; Goessl, 1917*), Brown (*Schuette, 1880*), Burnett (*Milwaukee Museum Expedition, 1909*), Douglas (*Milwaukee Museum Expedition, 1909*), Dunn (*Goessl, 1917*), Forest (*Goessl, 1916*), Lafayette (*Stuntz, 1893*), Manitowoc (*Benke, 1913*), Marathon (*Goessl, 1915*), Oconto (*Goessl, 1916*), Oneida (*Goessl, 1915*), Outagamie (*Goessl, 1916*), Price (*Finger; Graenicher, 1915*), Sauk (*Cheney, 1893*), Sawyer (*Fuller, 1925*), Shawano (*H. H. Smith, 1922*), Taylor (*Goessl, 1915*), Vilas (*Denniston and Timberlake, 1901; Peaslee, 1915*) and Washburn (*Cheney, 1897; Goessl, 1917*) Counties.

EQUISETUM VARIEGATUM Schleich. This species, although rare in Wisconsin, has been abundant in Castalia Park, Milwaukee County. This area has been subdivided, and this station will be destroyed in the near future. Brown (*Schuette, 1881*), Dane (*Hale; Cheney, 1894*), Door (*Houghton; Schuette, 1890; Fuller, 1926*), Iron (*Cheney, 1896*), Milwaukee (*Lapham; Graenicher, 1910; Steil, 1927*) and Sheboygan (*Schuette, 1879; Goessl, 1914*) Counties.

LYCOPODIACEAE

Lycopodiums are common in the northern Wisconsin woods. With the passing of the forests, they are doomed to extinction.

LYCOPODIUM ANNOTINUM L. Ashland (*Lapham, 1858*), Barron (*Cheney, 1888*), Bayfield (*Cheney, 1897*), Brown (*Schuette, 1882*), Door (*Millspaugh, 1919; Schuette, 1889*), Douglas (*Allen, 1915*), Oconto (*Schuette, 1884*), Oneida (*Cheney, 1893*), Sawyer (*Denniston, 1916*), Vilas (*Denniston and Timberlake,*

1901; Peaslee, 1915) and Washburn (*Goessl, 1917*) Counties.

LYCOPODIUM CLAVATUM L. Ashland (*Lapham, 1858; Goessl, 1917*), Barron (*Cheney, 1888; Goessl, 1917*), Bayfield (*Cheney, 1897*), Dane (*University of Wisconsin, 1893*), Door (*Schuette, 1883; Knudsen, 1910; Howland Russell, 1913; Goessl, 1916*), Douglas (*Milwaukee Museum Expedition, 1909; Allen, 1915; Goessl, 1917*), Dunn (*Weinzirl, 1893*), Kewaunee (*Goessl, 1916*), Manitowoc (*Benke, 1910*), Marathon (*Kremers, 1885*), Marinette (*Goessl, 1916*), Marquette (*Hartwell*), Milwaukee (*Bruhin*), Oconto (*Schuette, 1884*), Oneida (*F. W. Johnson, 1914; Kremers, 1914*), Price (*Graenicher, 1915; Goessl, 1915*), Racine (*Lapham*), Sawyer (*Denniston, 1916*), Taylor (*Goessl, 1915*) and Vilas (*Cheney, 1893; Peaslee, 1915*) Counties.

LYCOPODIUM COMPLANATUM L. Dry sandy soil; Barron (*Cheney, 1888; Goessl, 1917*), Bayfield (*Cheney, 1897*), Burnett (*Milwaukee Museum Expedition, 1909*), Chippewa (*Goessl, 1915*), Columbia (*Finger, 1904*), Dane (*Watson*), Douglas (*Cheney, 1897; Milwaukee Museum Expedition, 1909; Goessl, 1917*), Door (*Schuette, 1887*), Dunn (*Weinzirl, 1892*), Iron (*Goessl, 1917*), Juneau (*Fuller, 1927*), Lincoln (*Clowes, 1906*), Manitowoc (*Benke, 1910*), Marathon (*Kremers, 1883*), Marinette (*Schuette, 1891; Goessl, 1916*), Price (*Goessl, 1915; Escoll, 1917*), Oneida (*Cheney, 1893; R. E. Kremers, 1914; F. W. Johnson, 1914*), Rusk (*Goessl, 1915*), Sauk (*Lapham, 1858; Benke, 1911*), Sawyer (*Denniston, 1916; Fuller, 1925*), Shawano (*Goessl, 1916; H. H. Smith, 1922*), Taylor (*Goessl, 1915*), Vilas (*Peaslee, 1915; Goessl, 1915*) and Waushara (*Benke, 1913*) Counties.

LYCOPODIUM COMPLANATUM var. FLABELLIFORME Fernald. Solon Springs, Douglas County (*Allen, 1915*).

LYCOPODIUM INUNDATUM L. Ashland (*Cheney, 1896*), Brown (*Schuette, 1884*), Marinette (*Schuette, 1891*), Sauk (*Davis, 1921*) and Vilas (*Cheney, 1893*) Counties.

LYCOPODIUM LUCIDULUM Michx. Moist woods throughout Wisconsin; Adams (*Sylvester, 1886*), Ashland (*Cheney, 1896; Milwaukee Museum Expedition, 1907; Toole, 1920*), Barron (*Goessl, 1917*), Bayfield (*Cheney, 1897*), Chippewa (*Goessl, 1915*), Clark (*Goessl, 1915*), Dane (*Cheney, 1894; Field Club, 1901*), Door (*Schuette, 1887; Museum Expedition, 1905; Goessl, 1915*), Douglas (*Allen, 1915*), Dunn (*Goessl, 1917*), Florence (*Goessl, 1916*), Grant (*Sylvester, 1886*), Iowa (*Davis, 1902*), Lafayette (*Cheney, 1890*), Lincoln (*Cheney, 1893; Goessl, 1915*), Manitowoc (*Benke, 1910*), Marathon (*Goessel, 1915*), Marquette (*Hartwell, 1912*), Milwaukee (*Bruhin*), Oneida (*Goessl, 1915*), Price (*Graenicher, 1915; Escoll, 1917*), Sauk (*Davis, 1919*), Sawyer (*Denniston, 1916*), Vilas (*Cheney, 1893; Denniston and Timberlake, 1901; Jackson, 1917*) and Washburn (*Goessl, 1917*) Counties.

LYCOPODIUM LUCIDULUM var. POROPHILUM (Lloyd & Underw.) Clute. Dense woods, Dells of the Wisconsin (*Sylvester, 1886*).

LYCOPODIUM OBSCURUM L. Bayfield (*Cheney, 1897*), Oneida (*R. E. Kremers, 1914*) and Sauk (*True*) Counties.

LYCOPODIUM OBSCURUM DENDROIDEUM (Michx.) D. C. Eaton. Barron (*Cheney, 1888; Goessl, 1917*), Bayfield (*Goessl, 1917*), Brown (*Schuette, 1889*), Burnett (*Milwaukee Museum Expedition, 1909*), Chippewa (*Goessl, 1915*), Clark (*Goessl, 1915*), Door (*Schuette, 1883; Milwaukee Museum Expedition, 1905*), Douglas (*Milwaukee Museum Expedition, 1909; Allen, 1915*), Florence (*Goessl, 1916*), Forest (*Jackson, 1917*), Jackson (*H. H.*

Smith, 1922), Juneau (*Mrs. E. B. Pope, 1916*), Lincoln (*Clowes, 1906*), Manitowoc (*Benke, 1910*), Marathon (*E. Kremers, 1883; Cheney, 1894; Goessl, 1915*), Marinette (*Goessl, 1916*), Oneida (*Jackson, 1909; Goessl, 1915*), Outagamie (*Goessl, 1916*), Price (*Graenicher, 1915; Escoll, 1917*), Rusk (*Goessl, 1917*), Sawyer (*Denniston, 1916*), Shawano (*Goessl, 1916*), Sheboygan (*Fuller, 1925*), Vilas (*Cheney, 1893; Milwaukee Museum Expedition, 1907; Peaslee, 1915; H. H. Smith, 1921*), Waushara (*Goessl, 1913*) and Washburn (*Goessl, 1917*) Counties.

LYCOPODIUM TRISTACHYUM Pursh. Ashland (*Cheney, 1896*), Bayfield (*Richardson, 1914*), Brown (*Schuette, 1880*), Door (*Millspaugh, 1919*), Marquette (*Hartwell*), Milwaukee (*Lapham*), Oneida (*Davis, 1892*) and Sauk (*E. Kremers, 1888*) Counties.

SELAGINELLACEAE

SELAGINELLA APUS (L.) Spring. This species has been collected only in the eastern counties. It grows in moist places. Door (*Schuette, 1887*), Manitowoc (*Steil, 1920*), Milwaukee (*Lapham, 1860; Howland Russel, 1908*), Ozaukee (*Graenicher, 1909*) and Walworth (*Vasey, 1860*) Counties.

SELAGINELLA RUPESTRIS (L.) Spring. This species is common throughout the state on exposed rocks and sand barrens. Adams (*Fuller, 1925*), Bayfield (*Cheney, 1896*), Columbia (*Benke, 1911*), Dane (*Lapham, 1848; Field Club, 1901; Heddle, 1916*), Dunn (*Goessl, 1917*), Eau Claire (*Goessl, 1915*), Florence (*Goessl, 1916*), Grant (*Davis, 1916*), Iowa (*Heddle, 1911; Davis, 1921*), Jackson (*Davis,* 1916), Juneau (*Fuller, 1927*), Lafayette (*Cheney, 1888*), Lincoln (*Goessl, 1915*), Marinette (*Goessl, 1916*), Polk (*Baker, 1897; Davis, 1914*), Richland (*Davis, 1921*), Sauk (*Lapham, 1865; Cheney, 1893; Davis, 1921*), Shawano (*Goessl, 1916*), Sheboygan

(*Fuller, 1925*), and Waushara (*Finger, 1911*) Counties.

SELAGINELLA SELAGINOIDES (L.) Link. In the herbarium at the Field Museum, Chicago, there is a specimen of this species collected by Schuette at Sister Bay, Door County, in 1887.

ISOETACEAE

This group of plants have been overlooked by most of our Wisconsin collectors. Several undetermined species have been abundant in Devils Lake, Sauk County. Undetermined species have also been reported from other lakes in Wisconsin.

ISOETES ECHINOSPORA VAR. BRAUNII (Dur.) Engelm. In regard to this species, Dr. C. E. Allen, of the Department of Botany at the University of Wisconsin writes: "I collected this species and also a specimen of another unidentified species at Cable, Bayfield County, in August, 1918. These two species grow in extremely shallow water or even occasionally on the sand above the water's edge, and I have seen one or both of them in a number of the small lakes in the northern part of the state."

ISOETES MACROSPORA Dur. Davis collected this species near Hayward, Sawyer County, August, 1924.

Notes on Northwestern Ferns[1]

HAROLD ST. JOHN

BOTRYCHIUM MINGANENSE Vict., Contrib. Lab. Bot. Univ. Montréal, No. **11**: 331. 1927.

Brother Marie-Victorin recorded his new species at various stations from Banc-Sablon, Labrador, to Alberta, and south in the mountains to Colorado and California. From this broad range, it was obvious that the plant might well appear in the state of Washington. A search has revealed the two following specimens.

WASHINGTON: evergreen woods, Bonaparte Lake, alt. 3700 ft., Colville National Forest, Okanogan Co., July 10, 1921, *St. John, Courteny & Parker* 5373; alpine slopes, 4500 ft. alt., Winchester Mt., Whatcom Co., Sept. 8, 1927, *St. John* 9286. The determination of the latter specimen was kindly verified by Brother Victorin.

BOTRYCHIUM **pinnatum** St. John, n. sp.

Plant slender or stout, 3–12 cm. high; rhizome dark short and vertical, with an abundance of dark brown roots 1 mm. or less in diameter; bud smooth entirely enclosed in the sheathing base of the stalk, the sterile and fertile segments entirely reflexed; common stalk one third to one half hypogaean, 3–7 cm. tall; the sterile segment sessile or on large plants short stalked, not glaucous, once pinnate or on large plants twice pinnate, the blade oblong or somewhat narrowed to the tip, the simply pinnate blades having 7–11 pinnae which are sessile broadly winged and confluent with the rhachis entire or frequently with large rounded pinnate lobings, the pinnae ovate or elliptical 3–5 mm. long, prominently veined with twice forked veins; sterile segment of large plants ovate-deltoid, twice pinnate, 4 cm. long, 3 cm. wide, the pinnae pinnately cut and closely resembling the whole blade of a smaller plant; stalk of the fertile

[1] Contribution from the Botany Department of the State College of Washington, No. 17.

segment exceeding the sterile segment; fertile segment once to thrice pinnate, erect, narrow and with ascending branches; spores rounded tetrahedral 36–45 μ in diameter, rugose.

Planta 3–12 cm. alta, rhizomate verticali, gemma glabra segmentis sterilibus fertilibusque reflexis, segmento sterile pinnato oblongo partibus ovatis vel ellipticis, segmentis fertilibus anguste erectis pedunculatis, diodiis 36–45 μ longis.

WASHINGTON: On damp ground near a spring on steep mountain-slope, Mt. Paddo (Adams), Aug. 12, 1910, *Wilhelm Suksdorf* 7075 (type in Herb. State College of Washington); Mt. Adams, Aug. 7, 1885, *W. N. Suksdorf* 1220; Mt. Rainier, Pierce Co., Oct. 1888, *E. C. Smith*.

The identification of these specimens has caused no end of trouble and divergence of opinion. The *Smith* specimen was determined first as *B. simplex*. Then Prof. C. V. Piper redetermined it as *B. Lunaria*. On this evidence together with *Suksdorf* July 11, 1886 from Mt. Adams, he included *B. Lunaria* in his Flora of the State of Washington. About two years ago the writer borrowed this *Suksdorf* specimen and decided that it was the same species as *Suksdorf* 1220. Were it not for further collections it would be necessary to exclude *B. Lunaria* from the state flora. Typical specimens of this species have recently been collected at the Pasayten Ranger Station, Okanogan Co., *Eggleston* 13248, and another collection was subsequently made on the slopes of Mt. Baker by *H. L. Mason*. This same *Smith* specimen was redetermined a few years ago by the writer as *B. simplex*. It has just been referred to Brother Marie-Victorin who decided that it was not *B. minganense*, but of the *B. ramosum* group.

The collection from Mt. Adams, *Suksdorf* 1220 was originally determined as *B. matricariæfolium*. Then about the year 1900, at the request of Prof. Piper, W. R.

Maxon studied the plant, and labeled it, "an *unusual* form, but assuredly *B. neglectum.*" Prof. Piper accepted this view and on this solitary record included the species in his Flora of the State of Washington. In 1918 the sheet with its solitary plant was again referred to Dr. Maxon. Then he redetermined it as *B. simplex.* Last year the writer studied the plant and concurred with Maxon that it was *B. simplex.* Brother Marie-Victorin has just examined it and decided that it is not *Lunaria, simplex,* or *minganense,* but of the *ramosum* group.

The recent collection of the plant from Mt. Adams, *Suksdorf* 7075 was distributed under the name *B. ramosum.* It will be seen that each botanist who has studied the plants has shuffled them into a different cover. As it so frequently turns out in such cases, the plant has abundant characters to separate it from all of the others to which it has been referred.

The new *B. pinnatum* does not closely simulate any described species. Perhaps it is most similar to *B. ramosum* (Roth) Aschers. This is distinguished by having the common stalk mostly epigaean, the sterile segment with a stalk 0.2–1.7 cm. long and the divisions mostly narrowly oblong, and the lamina with only the upper part bent down in vernation. *B. pinnatum* has the common stalk one third to one half hypogaean, the sterile segment usually sessile, the divisions mostly ovate, and the lamina entirely reflexed in vernation.

Contrasting differences will also be given for the other species that might possibly be confused with this new one. *B. Lunaria* (L.) Sw., var. *onondagense* (Underw.) Clute has the common stalk mostly epigaean, the divisions of the sterile segment fan-shaped, cuneate at base and remote, and the lamina with the tip bent down in vernation. *B. pinnatum* has the common stalk one third

to one half hypogaean, the divisions of the sterile segment ovate to obovate to elliptic, confluent at base, approximate, and the lamina entirely reflexed in vernation. *B. lanceolatum* (S. G. Gmel.) Ångstr. has the sterile segment divided into linear-lanceolate divisions. *B. pinnatum* has the sterile segment divided into broad, rounded, usually ovate segments.

B. pumicola Cov. has the lower portion of the stem thickly sheathed with the dark brown remnants of the stems of previous years, the frond glaucous, the sterile segment ternate with the ultimate divisions fan-shaped, the fertile segment scarcely exceeding the sterile, and the bud with the sterile segment erect in vernation. *B. pinnatum* has the stem base not sheathed, the frond not glaucous, the sterile segment usually simply but on large plants doubly pinnate with the ultimate segments ovate obovate or elliptical, the fertile segments on a slender stalk that equals or exceeds the sterile segment, and the bud with the sterile segment entirely reflexed in vernation.

CHEILANTHES **densa** (Brack.) St. John, n. comb.

Onychium densum Brack., in Wilkes U. S. Expl. Exped. **16**: 120. 1854.

Cheilanthes siliquosa Maxon, Am. Fern Journ. **8**: 116. 1918.

Dr. Maxon has presented a careful analysis of the structure and relationship of this fern. He showed that it is close to, and certainly not generically distinct from, *Cheilanthes californica* (Hook.) Mett. These two might be put in the genus *Mildella*, were that maintained, but Maxon's presentation of the morphological facts and his logical argument show that *Pellaea densa* is best placed in the genus *Cheilanthes*. Because of the earlier *C. densa* (J. Sm.) Fée, he renamed our plant *C. sili-*

quosa Maxon. That seems a satisfactory disposition for the followers of the American Code. The International Rules, on the other hand, do not seem to require the coining of this new name. *Cheilanthes densa* (J. Sm.) Fée[2] was evidently founded on *Notholaena densa* J. Sm.[3] in which sense it is still used by Copeland. This is referred by Christensen as a variety under *Notholaena hirsuta* (Poir.) Desv. Hence *Cheilanthes densa* Fée is not maintained as a species in the genus *Cheilanthes*. Mr. C. A. Weatherby, who has kindly aided the writer of these notes, indicates that even in such a case, the species of Fée may not be considered a pure synonym. It is still kept as a distinct variety, and when two such good pteridologists as Mettenius and Moore place it in *Cheilanthes*, it is quite possible that some later monographer may do so again.

Still there is another factor that has not been considered. *Notholaena sulcata* Link[4] is an earlier name for *densa* of Fée. It is a valid name without a homonym under either *Cheilanthes* or *Notholaena*. Consequently *Cheilanthes densa* (J. Sm.) Fée becomes a pure synonym of *C. sulcata* Link. Then the existence of *C. densa* (J. Sm.) Fée, an invalid homonym, does not prevent the adoption of the later homonym for the species under consideration. As *Onychium densum* Brack.[5] provides an earlier name within the specific category than does *Cheilanthes siliquosa* Maxon,[6] it is necessary to use the combination *C. densa* (Brack.) St. John for this interesting xerophyte.

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[2] Gen. Filicum. 156. 1850–52.

[3] Journ. Bot. 3: 395. 1841.

[4] Hort. Berol. 2: 367. 1833.

[5] Wilkes U. S. Expl. Exped. 16: 120. 1854.

[6] Am. Fern Journ. 8: 116. 1918.

CRYPTOGRAMMA STELLERI (Gmel.) Prantl.

The Slender Cliff-brake was first recorded for the state of Washington by Maxon in the first volume of Abrams' *Illustrated Flora of the Pacific States*. He records it from the Wenatchee Mountains. A second locality can now be added.

WASHINGTON: moist crevices of limestone cliffs, Z-Canyon, Pend Oreille Co., June 23, 1924, *St. John* 6452. It is particularly desirable to put this on record, as recent water power developments threaten to destroy the station.

PITYROGRAMMA TRIANGULARIS (Kaulf.) Maxon.

This quaint little Gold-fern is well known from Vancouver Island to Lower California and Nevada. In the northern part of its range, all known localities are west of the Cascade Mountains. Two noteworthy recent collections have been made far to the east of that Mountain barrier. They are from:

WASHINGTON: moist crevice, Granite Point, Snake River canyon, Whitman Co., March 12, 1921, *St. John & Pickett* 2999.

IDAHO: dry shale soil, under rock, Big Canyon Creek, T. 27 N., R. 2 W., Idaho Co., April 7, 1928, *Skillin & Warren* 740.

Both of these localities are in the deep part of the Snake River Canyon, where the river has cut down through the 2000 feet or more of basalt to the crystalline and sedimentary rocks below. In an air-line these new localities are 204 and 250 miles from the nearest known locality in the Cascade Mountains.

PULLMAN, WASH.

Isoetes Lechleri Mett.

T. CHALKLEY PALMER

During July, 1928, I received from Dr. W. R. Maxon, at the U. S. National Museum, a large number of specimens representing a gathering of Isoetes made in Colombia. These were collected by Messrs. E. P. Killip and Albert C. Smith (No. 17964.) during the exploration in Colombia under the auspices of New York Botanical Garden, Gray Herbarium, U. S. National Museum, and Arnold Arboretum. The date of collection is Jan. 21, 1927, and the Eastern Cordillera locality is "Dept. Santander; Laguna de Cunta, edge of Páramo de Santurbán, alt. 3880 meters." Environment: "Rooting in mud in shallow water at margin. Usually submerged but often aquatic and even entirely terrestrial." All the plants are rather small, but many of them bear sporangia packed with mature spores.

A careful examination of these specimens revealed features approximating those of the Peruvian species *I. Lechleri* Mett. as described by A. Braun (Verh. des Bot. Verein fur Brandenburg. 4. 1862.) It is to be noted in this connection, that Braun's *I. socia* and *I. Karstenii*, the latter from Venezuela (loc. cit.), were, apparently with Braun's concurrence, united with *I. Lechleri* by Motelay and Vendryes (Actes Soc. Linn. Bordeaux. 36. 1883.) These forms are alike in showing smooth megaspores and complete velum. The other Peruvian species, *I. triquetra* A. Br. is without velum and has tuberculate megaspores.

It seems almost impossible to obtain any authentic material of these South American forms. Mr. E. P. Killip, Associate Curator at the U. S. National Museum, kindly loaned me a sheet of specimens collected in Argentina, Feb. 2nd, 1887, by Hieronymus (No. 774) and

labelled by him *I. socia*. It bears a notation by the late A. A. Eaton reading in part as follows: "Not *I. Lechleri* (of which *socia* is a synonym) nor does it agree in any essential with other S. American species * * *. I propose the name *I. Argentina* * * *." Then follows Eaton's diagnosis. I am constrained to agree with Mr. Eaton. It is to be regretted that Dr. N. E. Pfeiffer ignored this note, dated 2. 1. 1900, and took these specimens as a basis for the description of *I. Lechleri* in her Monograph of the Isoetaceae, (Annals Missouri Botanical Garden, 1922.) The net result is an unnecessary addition to the trials in store for those who would fain know something of the systematology of Isoetes.

Now these specimens of Killip and Smith (No. 17964) agree approximately with previous descriptions of *I. Lechleri* such as that of A. Braun (loc. cit.). But there are certain peculiarities that would seem important enough to warrant the erection of a new variety. In order to clarify matters a little, if that be possible, I submit the following full diagnosis, in place of merely mentioning differences.

ISOETES LECHLERI Mett. var. **Colombiana** var. nov.—Corm bilobed, small. Leaves 5–7 cm. high, firm, narrowed above to corneous, often dark-brown tips about 1 mm. long; membranous wings at base yellow-brown; peripheral bast-bundles none, stomata few or absent. Ligule thin, rotund, lacerate. Velum thick, complete. Sporangium ellipsoidal, 3 mm. long, 2 mm. broad, thin-walled, with faint, dark-red spots. Megaspores 390–484 μ diameter, white, smooth, commissural ridges bold, smooth, ending below in overhanging points, equatorial ridge nearly or quite obsolete. Microspores 21–28 μ long, creamy white, sparsely warted.—Type: Killip and Smith No. 17964 Colombia, Jan. 21, 1927.

The obsolescence of the equatorial ridge of the megaspore is a pronounced feature. According to A. Braun,

there is a similar condition in *I. Perralderiana*, but there is no intimation of it in *I. Lechleri.* For the rest, the small microspores and the corneous leaf tips are worthy of note.

In addition to the normal megaspores as described, several sporangia in this material yield many with faces between the commissures more or less flattened, and with all surfaces minutely broken into very closely woven, convoluted wrinkles. These spores, often as large as the smooth, globular ones, seem to present a case of arrested development. Puzzling instances of the same sort are not infrequent in familiar species.

My thanks are due to Dr. W. R. Maxon for specimens of this gathering, and to Dr. E. P. Killip for the loan of other material in this connection.

DELAWARE COUNTY INSTITUTE OF SCIENCE,
MEDIA, PENNA.

The Propagation of Ferns

H. B. DOBBIE

The growing of ferns from their seed[1] I have found an easy, but very slow process. As I have met with a good deal of success and my plan is very different from any methods I have seen in print, and all my requisites are home made and inexpensive, I will give a brief outline.

First of all I gather a few fruitful fronds, put them in a paper bag and pin it to the wall of my study. In about six weeks I shake the bag, rub the seeds off the fronds and collect them. There is a layer of hardish red stone a foot or so below the surface in my garden

[1] Mr. Dobbie habitually uses "seed" in place of the usual "spore," believing that, as their functions are similar, he is justified in employing the less technical term for amateur readers, even though the structure of seed and spore is quite different.—Ed.

Left to right: Block with young ferns ready to pick off. Block scraped clean for sowing. Glass shade. All on inverted tray. One third size.

that can be split with a spade; it is a species of hematite found in many places in the Auckland Province. This I cut into blocks—see figure 1—to suit the glass shades (fruit jars cut in two with a hot wire and cold water) that are necessary to keep out stray seeds floating in the air. In my first attempt with the seeds of the "Gully Fern" (*Cyathea Cunninghamii*) I neglected this precaution. A fine crop of seedlings came up, and I was congratulating myself on having a good supply of this somewhat rare tree fern, when, to my disgust, the seedlings developed creeping roots; they proved to be *Hypolepis tenuifolia*, a luxuriant plant of which was growing in my fernery twenty yards away. There was not a single tree fern.

To continue:—I scraped the blocks to get rid of any stray seeds, dipped them in water, sprinkled the seeds over the surface, set them in a shallow tray with about half an inch of water in it, placed the glass covers over the blocks, and then possessed my soul in patience, keeping the tray filled with water, as it rested on a shelf in my study. In several months a green moss appeared on the blocks, the prothallia of the ferns, but it was eighteen months to two years before they were large enough to pick off and plant in small flower pots.

The trays are made of galvanized iron twelve inches by twenty-four inches and one inch deep. So far I have not succeeded with the genera of more complex seeding such as *Gleichenia*, *Todea*, *Marattia*, *Lorsoma*, but most of the others grow easily. I stand the pots in the same shallow trays for convenience of watering.

In my study where I am writing this article, a dozen strange ferns are growing luxuriantly from seeds sent to me by Professor Poirault, of Antibes, in the south of France (whom I supplied with seeds of New Zealand ferns). It is over three years since I sowed the seeds—see figure 2.

Three year old ferns grown by the author's method.

A foot or so below the hematite in my garden are thicker strata of a very soft grey stone—tufa I believe; this is a volcanic region. Thinking that the tender plants would thrive better on the more yielding foundation I tried several, but never succeeded in getting anything to grow, not even moss; for twelve months they have remained quite bare. An old brick or a dirty flower pot give better results. Nothing that I have experimented with answers so well as the hematite.

I have had one curious experience. However careful I am to isolate the blocks I always get a few plants of Maidenhair (*Adiantum*), not the New Zealand varieties, but imported species. The seeds must be very small and ubiquitous. These Maidenhairs are grown in the Auckland ferneries for making wreaths.

The growing of ferns from seeds is an inexpensive, harmless hobby; it is most interesting to watch the strange fronds unfolding. At present none of M. Poirault's species that differ most from our New Zealand species have seeded so that I can only guess the genera to which they belong.

To grow ferns successfully it is necessary to study the sites selected by nature. Some grow best in the blazing sun, such as the sweet-scented fern (*Pteris scaberula*) *Hypolepis Petrieana*, and our old friend the bracken, while the "Woolly Cloak fern" (*Notholaena distans*) selects the sunny side of a rock, growing in fissures and depressions that contain a little earth. Others again, like *Nephrodium unitum* and *N. Thelypteris* do not mind the sun so long as their roots are in water. I prefer growing tree ferns from seedlings, but it is not every one who can recognize the species when very young.

There are also some ferns that refuse transplantation, such as *Gleichenia Cunninghamii*, although our other species of *Gleichenia—flabellata, circinata* and *dicarpa*—

move quite easily. I have never succeeded with the Lindsayas, my failure is possibly due to the wrong constituents of the soil.

AUCKLAND, NEW ZEALAND

The Occurrence of Three and Four-Angled Branches in Equisetum Arvense[1]

JOHN H. SCHAFFNER

It has been supposed that *Equisetum arvense* L. normally and typically has four-angled branches with four-toothed leaf sheaths. Thus the key in Britton and Brown's ILLUSTRATED FLORA reads: "Sheaths of branches of sterile stems 4-toothed. 1. *E. arvense*" and "Branches of the stem simple, their sheaths 3-toothed. 2. *E. pratense.*" On the strength of this diagnosis, no doubt, some one, years ago, went through the *arvense* specimens in the Ohio State Herbarium and sorted them out as two species, labeling those with prevailingly four-angled branches as *E. arvense* L. and those with prevailingly three-angled branches as *E. pratense* Ehrh.

Recently Brother Victorin in his "LES ÉQUISÉTINÉES DU QUÉBEC" has recognized *E. arvense boreale* as a valid variety, supposing that typical *E. arvense* L. has four-angled branches and four-toothed sheaths and to be comparatively southern in its distribution. The plants with three-angled branches and three-toothed sheaths are designated as var. *boreale* (Bong.) Rupr. and are considered to have a northern distribution from Quebec to Labrador and Greenland.

Since this view of the case did not at all agree with my own previous observations, gained both from field

[1] Papers from the Department of Botany, The Ohio State University. No. 225.

studies and herbarium material, I thought it worth while to investigate the matter again. At Columbus, Ohio, one can find shoots on which the branches are practically all uniformly four-angled, others on which the branches are practically all three-angled, or completely so, and still others which have part of the branches four-angled and part three-angled. Secondary branches may be three-angled and arise from either three-angled or four-angled primaries, or they may be four-angled. Either primary or secondary branches may be four-angled at the base and three-angled toward the tip. Some of the large branches, even of regular whorls, may be five-angled with five-toothed leaf sheaths.

Specimens from many other places in Ohio, including large collections from Cedar Point, Erie County, show the same range of diversity, as also material from Salisbury, Mass., Washington, D. C., Veedersburg, Ind., Effingham, Ill., Pittsfield, Ill., Baldwin, Kan., Morganville, Kan., Switzerland, Germany, Sweden, and Russia. It is evident, therefore, that the three- and four-angled branch characters are of no value for delimiting either a definite morphological variety or a geographic fluctuation, although it is probable that the more unfavorable conditions of growth in northern regions would favor the production of three-angled branches, since the number of angles and sheath segments in Equisetum in general is subject in most cases to extreme fluctuation, depending on the size of the growing bud.

The development of shoots with three- or four-angled branches or a combination of the two sorts is not due to hybridization and segregation of two interbreeding genetic varieties in the central United States but is a pure fluctuation.

The so-called var. *boreale* apparently has no more definite characteristics to segregate it from the species than

a large number of other fluctuations of *arvense* that have been described as definite varieties. A specimen from Victoria, B. C., distributed by A. A. Eaton as *E. arvense boreale* (Bong.) Rupr. has branches with three and four angles and I can distinguish nothing else that would separate it as a variety or even a recognizable fluctuation from the ordinary *E. arvense*. Another specimen distributed by Eaton, from Seabrook, N. H., and labeled *E. arvense arcticum* Rup. by him, has mostly three-angled branches but also some four-angled ones. It is evident, therefore, that if one would base the validity of the variety *boreale* on the character of its branches one would have to pull his plants to pieces and name the dissected parts separately; for it is really quite difficult, in the central United States at least, to find an entire *Equisetum arvense* plant that does not produce some three-angled branches along with the four-angled ones. The characters used to segregate *E. boreale*, either as a species or distinct variety, are mere fluctuations which do not have even a distinct geographic range.

COLUMBUS, OHIO

Recent Fern Literature

Members of the American Fern Society will be interested to know about Professor Schaffner's "*Field Manual of the Flora of Ohio,*" which has just been published. The Manual starts with a consideration of ferns and other pteridophytes, the plants commonly known as fern "allies." The key to the ferns, etc., takes up just twenty pages. Of special interest is the treatment of Equisetum, summarizing as it does in compact form Professor Schaffner's very intensive and extensive studies of this genus.

The list will serve a useful purpose as an introduction to the ferns and flowering plants of Ohio. It is also valuable as the most recent list of Ohio pteridophytes. The scientific names used follow the standard American code of priority and thus agree in general with the Britton & Brown nomenclature. They contain also complete synonymy to cover Gray Manual names.

The book, which is of small size, capable of being carried in a pocket for use in the field, is published by R. G. Adams Company, Columbus, Ohio.

Shorter Notes

THE HARTFORD FERN.—Some time ago I had the privilege of visiting, in company with two other members of the Fern Society, an apparently unrecorded station for the Hartford, or Climbing, Fern. This station is in the Connecticut Valley near the city of Holyoke, Mass.

The dainty climbing fronds are exceedingly abundant. They grow in a poor, sandy soil underlaid by clay, which holds the moisture not far below the surface. An abundance of birch saplings provides plenty of natural trellis for the climbing fronds, together with partial shade. To see thousands of these ferns within a small area is indeed a beautiful sight and one that is rare in New England now. As Mr. Weatherby says: "It is a wonderful stand of the fern; seeing it for me was like going back twenty-five years to the time when 'Hartford fern' still deserved that name."

It would be a great pity to have such a station despoiled, and it is to be hoped that it may be kept intact as one of the few remaining stands of any considerable size still left in New England.—WALTER S. ALLEN, *Flushing, N. Y.*

The *New York Tribune* has long been my favorite newspaper. During the past summer that predilection was even further strengthened by the following editorial, which reads as if it had been written by some Fern Society member. Certainly it deserves quotation in the FERN JOURNAL.—R. C. B.

"Fern Faces

Why not, in July, turn to the ferns? A thousand people know birds, or flowers, to one who knows ferns. Because they have no bright-colored flowers there is a superstition that they are difficult. But they have one vast advantage to the lazy amateur: there are few of them.

Sixty kinds of ferns have been found in New York State, but half of these are rare, and others only locally frequent. Instead of puzzling through the mysteries of the multitudinous asters and goldenrods, the countless violets and hawthorns, the mustards, parsleys, crowfoots, roses and the pea tribe, one may claim himself a citizen of ferndom when he has a speaking acquaintance with twenty-five species. And many a man is surprised to discover how many fern faces he already knows.

We all know the delicate maidenhair, and the Christmas fern, so like the Boston ferns of the flower-pots. If we use our eyes we recognize in the woods the spinulose shield fern, the old friend which the florist packs with his roses. The coarse three-plied bracken of the sunny pastures is equally familiar. Most of us, without knowing its name, recognize the stub-fingered polypody which grows in thick mats on shaded rocks. Then there are the tall ferns of the open brooksides and meadows—the plumy ostrich fern so aptly named that to see it is to know it; the interrupted fern, whose middle frondlets

look withered but are in fact rich with fertile spores; and the handsome cinnamon fern, which at this season holds its russet spikes proudly erect within a circle of shiny fronds. Those dense tufts of foliage about the pasture bowlders are likely to be hay-scented fern or lady fern. Crush it, and smell it, and you can guess the answer. Or turn the frond; if the fruit-dots are round, it is hay-scented; if long and narrow, lady fern.

In the open swamps you will add the coarse-lobed sensitive fern and the saw-toothed marsh fern; in the woods the delicate oak and beech ferns and the evergreen marginal shield fern, the fruitful dots of which cling to the very edges of the frond. But the real joy of fern hunting comes when you begin to hunt the rock walls for purple cliff brake and rusty woodsia, to search the crevices for maidenhair spleenwort and fragile fern. There is always hope of finding one new fern—but never the overwhelming abundance that appalls the beginner who faces the infinitude of species of the flower or insect worlds."

HART'S TONGUE CONSERVATION NOTES.—So far, most of the effort toward naturalizing the hart's tongue in new localities has been concerned with the distribution of plants, either taken from the native region in central New York or raised from spores at the Brooklyn Botanic Garden. It remains to be seen how far the experiment will succeed. We are still asking that those who have set out grown plants, and who have not already reported as to present health and growth of these plants, do so as soon as possible so that a judgment may be reached re-garding this first experiment.

New spore sowings have been made from which we hope to have a good supply of additional young plants for distribution next spring. In the meantime, I would

like to suggest another method as worth trying: namely, the broadcasting of spores in favorable natural situations. I have recently received from Dr. Todd a supply of spore leaves from this past summer's crop, more than are needed in our greenhouse culture work. So long as they last, I will be glad to send them out to applicants who are interested to sow the spores in natural situations.

A start along this line has been made by Mr. G. J. Boehland, of Rockford, Ill., who has a large natural tract in which native plants are encouraged and protected. From a recent letter, the following quotation, with the list of fern species now at home, gives promise that the hart's tongue may find itself in favorable circumstances. Among those listed, the first six or seven are constant associates of the hart's tongue in its natural haunts in New York State.—R. C. BENEDICT, *Brooklyn Botanic Garden.*

"The following are some of the ferns that are growing on my grounds. I have the Bulblet Bladder Fern growing in great profusion on the limestone and in natural beds that I have arranged for them. I think I enjoy this fern more than any other one.

Common Polypody
Maidenhair
Purple Cliff Brake
Slender Cliff Brake
Lady Fern
Walking Leaf
Shield Fern
Sensitive Fern
Ostrich Fern
Royal Fern
Interrupted Fern
Cinnamon Fern
Rattlesnake Fern

I have patches of the Walking Leaf Fern on the limestone rock on the farm, some covering as much as three square yards. At the bottom of the rocks along the hillside we have Hepatica and Bloodroot in great numbers and when these are in bloom it is certainly quite a sight. The Hepaticas come in a great profusion of color."

CONSERVATION OF NATIVE PLANTS IN ENGLAND.—Two items of news have recently come to hand which carried the rather unexpected information that the conservation of native plants is a matter of concern in England as well as in America. The first came by way of a letter which told of a conference called to consider the whole problem. The other is found in a note in the *British Fern Gazette* (No. 5:224. June, 1928) and is reprinted below.

"A FERN SANCTUARY FOR STAFFORDSHIRE.—We learn from our member, the Rev. E. A. Elliot, that a Nature Reserve has been formed at Hawksmoor, North Staffs, and it is proposed to form colonies of the fern flora which formerly existed in the county but of which it has been, in great measure, denuded. We applaud the scheme, which might well be copied by other counties and districts, and commend it to our readers. If moderate colonies of wild species can be established, and protected from marauders, they may reasonably be expected to form nuclei from which the species may spread over a wider area. If any members of our Society, or other sympathizers, have surplus garden specimens of any species to give away, they will be appreciated by the committee and the givers will be performing a real service to lovers of nature in the county. It is not suggested that wild ferns should be uprooted because this would only be, at best, 'robbing Peter to pay Paul,' but there are many gardens where wild species spring up from stray spores and these can be utilized with advantage. Communication may be made to Mr. J. R. B. Masefield, Rosehill, Cheadle, Staffs, who will be glad to receive and acknowledge them."

SKELETONIZED LADY FERN.—In the *British Fern Gazette* for June, 1928, the following comments are

made regarding Mrs. Chisholm's note on an unusual form of Lady fern:

"Another communication (Journal, March, 1928) refers to a find of a plant of *Athyrium filix-foemina* having some of the fronds 'skeletonized' while others are normal. Figures are given of both kinds of fronds and it is evident that the fern is a *lineare* form of the Lady fern. We are here quite familiar with this type of variation in *Polystichum angulare* and *Lastrea filix-mas*, and it is not uncommon for some of the fronds to be normal, especially in the young state. It has also been found in *Athyrium*, e.g., the varieties *Girdlestoneii* and *abasilobum*. The present writer found one in Wales in 1919, but it was accidentally lost before we reached home."

American Fern Society

LABOR DAY FIELD MEETING.—As recorded by Mrs. Chisholm in this journal,[1] the Society held a field meeting in July, 1926, as guests of Professor Will S. Monroe and Scottie at Couching Lion Farm near North Duxbury (Post Office, Waterbury), Vermont, and many members who had been unable to participate in that meeting were glad to learn that the Society was invited to come again, over Labor Day of 1928. This time it was a joint meeting with the Sullivant Moss Society (the Secretary of which, Mr. A. T. Beals, made all preliminary arrangements), the Torrey Botanical Club, the Vermont Bird Club, the Vermont Botanical Club, and the Wild Flower Preservation Society, and several representatives from each were present, amounting to twenty in all.

Plants of many of the commoner ferns and fern allies were seen, and small colonies of two rare ones, *Woodsia*

[1] AMERICAN FERN JOURNAL, Vol. 16, 128.

alpina and *Thelypteris fragrans hookeriana* (*Aspidium fragrans* of Gray's Manual) were discovered toward the upper end of the ravine of Scottie's Brook. The first two days the weather was glorious, but Monday turned out so rainy that the majority of the party left early that day, a few paying a brief visit to Smuggler's Notch later on. As a token of our appreciation of Professor Monroe's hospitality, Mr. J. H. Parker arranged to send a gift to him a few days later, and the acknowledgment of this may here be placed on record.—EDGAR T. WHERRY.

the third day of the tenth month
Anno Scottie IV.

My dear Mr. Parker and Associated Friends:

On behalf of Scottie and myself please accept our sincere thanks for the fine gift of a boat for his pond. You have placed me under a large debt of gratitude, and Scottie wants me to say that you must all come back to the farm next summer and have a ride with him in the boat.

As you may have the addresses of the generous friends of this handsome gift, perhaps you would be so kind as to send this letter of appreciation as a sort of round robin. I do not have the addresses of a number of the benefactors.

We are having a delightful late September and early October. The deciduous trees are assuming their rich autumn adornments; the red and yellow leafage on our mountain suggest bits of Tyre in the prevailing Eldorado color; and everywhere one sees the gorgeous hues of the purple and gold of royalty. How we wish you all might be here at this time to enjoy it with us.

With very warm regards, in which Scottie joins me, to Mrs. and Mr. Parker, Dr. Ware, Mr. Torrey, Mrs. and Mr. Crowder, Mrs. and Miss Knappen, Dr. Wherry, Mrs.

and Mr. Beals, Mr. and Miss Griswold, Ed. Fitzhugh, Eric Johnson, Bill Habada, Miss Kittredge, Mrs. Doubleday, and Miss Von Lincoholler, we are,

Very sincerely yours,
WILL S. MONROE
and SCOTTIE.

HAVE YOU A COMPLETE SET OF THE AMERICAN FERN JOURNAL?—This question is intended principally for the more recent additions to our coterie of readers and members. With the JOURNAL in its nineteenth year of existence—Volume 1, Number 1, appeared in August, 1910—we have come to a point where we can look back over a considerable history. The total number of pages issued to the end of 1928 is over 2,400, and this figure does not include cover pages, membership lists, or any similar supplementary material. The complete file of the FERN JOURNALS makes a pile seven inches in thickness.

All of which leads up to this suggestion: if you like the current numbers, you may be assured that the earlier ones are just as interesting. Their make-up has been the same: contributions of members and friends of items about ferns, ranging from popular narratives of experiences in fern hunting in various parts of the world to valuable technical reports of careful fern research. It has been our very satisfying experience during the past few years to find that a majority of those to whom sample copies of the JOURNAL are sent write in shortly afterward to apply for membership. The other day a most gratifying comment was made by a professor of botany at a leading university: "The FERN JOURNAL is always interesting. It is one botanical magazine of which I read every page."

It has been the policy of the management of the JOURNAL to encourage new members to acquire complete files by offering a discount of ten per cent. on all orders of six volumes or more. In this way, it is possible to add to one's files gradually without having to make the considerable expenditure which a complete file would require at any one time. (With the completion of Vol. 18 the full set is quoted at $23.25, less 10 per cent. to members of the Fern Society, $20.93.) Despite the rarity of several of the earlier numbers, it has not been our policy to raise prices on such numbers in any way commensurate with their scarcity. Rather we have been anxious to encourage our members to fill their sets. One early number which was entirely used up has been reprinted, so that complete files are still available. Before another year has passed, we shall almost certainly have to reprint one or more other early issues.

Approaching the beginning of our twentieth year of existence, there seems to be no diminution in the interest in the natural history and science of ferns. The editors' copy drawer is not so full that contributors have to wait an unduly long time, thanks largely to the policy of publishing extra pages whenever desirable, but it rarely happens nowadays that there are not enough, or nearly enough, articles for each succeeding issue some time before the current number has been distributed. It may be of interest to more recent members to know that each number is planned on the basis of thirty-two pages, making a volume of one hundred and twenty-eight. As it happens, this minimum has been issued only twice in the past eighteen years.

Finally, if you haven't a complete set of the FERN JOURNAL, we hope you will order one straightway. We are sure it will contribute to your pleasure and to your

understanding of ferns. It will also further strengthen the financial position of the Fern Society.

New members:

Boehland, G., Rockland, Ill.

Clayton, Ernest, 434 Laurel St., San Anselmo, Marin Co., Cal.

Hendee, U. G., Route 2, Box 134, Tucson, Arizona.

Looser, Gualterio, Casilla 5542, Santiago, Chile.

Marble, John E., 1313 Garfield Ave., South Pasadena, Cal. **(Life member.)**

Slifer, Mrs. Walter B., 56 Southern Parkway, Rochester, N. Y.

Changes of address:

Anderson, Flora C., to Haas, Dr. Flora Anderson, 736 East 3rd St., Bloomington, Ind.

Beals, Mrs. A. Tennyson, 5833 85th St., Elmhurst, N. Y.

Cornman, Mrs. Leighton R., 511 N Ave., Los Angeles, Cal.

Kaufman, Miss Pauline, 83 Argyle Ave., New Rochelle, N. Y.

Lewis, Rev. C. S., Trinity Rectory, Plattsburg, N. Y.

Stebbins, G. Ledyard, 38 Perkins Hall, Cambridge, Mass.

Stetson, Richard N., 7092 Hawthorne Ave., Hollywood, Cal.

Taylor, William Gavin, 6 Beech St., Arlington, N. J.

Thompson, J. W., Ballard High School, Seattle, Wash.

List of Members of the American Fern Society

SUPPLEMENT TO THE AMERICAN FERN JOURNAL, JANUARY, 1929

(*Charter Members; †Life Members; ‡Honorary Members)

Aiken, Walter H., 1520 Aster Place, Cincinnati, Ohio	1911
Allen, Dr. Fred H., 16 Fairfield Ave., Holyoke, Mass.	1921
Allen, Henry V. D., Care Canadian Dept., General Electric Co., Schenectady, N. Y.	1904
Allen, Walter S., 224 State St., Flushing, N. Y.	1917
Ames, Oakes, Botanical Museum, Oxford St., Cambridge, Mass.	1917
Amidon, Dr. Royal Wells, Chaumont, Jefferson Co., N. Y.	1911
Anderson, W. A. Jr., Dept. Botany, University of Tennessee, Knoxville, Tenn.	1927
Armstrong, Mrs. C. R., Trudeau, N. Y.	1906
Arnold, William T., 21 Park Rd., Wyomissing, Pa.	1919
Atwood, Dr. Charles, 11 Church St., Moravia, N. Y.	1912
Baber, E. A., Longview Hospital, Cincinnati, Ohio	1926
Bailey, Dr. Liberty Hyde, Ithaca, N. Y.	1921
Baker, Prof. H. R., Dept. Botany, University of Delaware, Newark, Del.	1927
Barnes, Mrs. Albert C., Barnes Foundation, Latch's Lane, Merion, Pa.	1926
Barnes, Franklin Augustus, P. O. Box 44, Bellona, Yates Co., N. Y.	1914
Barnhart, Dr. John Hendley, New York Botanical Garden, New York, N. Y.	1911
Barrie, George N., Roughwood, Chestnut Hill, Mass.	1925
Bartsch, Dr. Paul, Smithsonian Institution, Washington, D. C.	1911
Bates, Miss Amy L., Park Museum, Providence, R. I.	1926
Baxter, M. S., 46 Bly St., Rochester, N. Y.	1912
Beals, Mrs. A. Tennyson, 5833 85th St., Elmhurst, N. Y.	1928
Bean, Ralph C., 48 Emerson St., Wakefield, Mass.	1920
Beck, Mrs. Walter Innisfree, Millbrook, N. Y.	1928
Benedict, J. E. Jr., 945 Pennsylvania Ave., Washington, D. C.	1923
Benedict, Dr. Ralph Curtiss, 1819 Dorchester Rd., Brooklyn, N. Y.	1905
Benfield, Rev. W. A., Link's Grove, West Virginia	1924
Bill, Mrs. G. E., 819 Third St., Harrisburg, Pa.	1922
Birger, Dr. Selim, Grefturegatan 3, Stockholm, Sweden	1922
Boehland, G., Rockland, Ill.	1928
Bond, Miss Nancy K., 201 East Seventh St., Superior, Wis.	1924
Boughton, Fred S., Pittsford, N. Y.	1917
‡Bower, Prof. Frederic Orpen, 2 The Crescent, Ripon, England	1926
Braun, Miss E. Lucy, 2702 May St., Cincinnati, Ohio	1920
Bray, Dr. William L., 1005 Harrison St., Syracuse, N. Y.	1916
Breckenridge, Prof. Lester Paige, North Ferrisburg, Vt.	1915
Britton, Mrs. Elizabeth Gertrude, 2965 Decatur Ave., New York, N. Y.	1911
Britton, Dr. Nathaniel Lord, New York Botanical Garden, New York, N. Y.	1911

Brooks, Maurice G., French Creek, West Virginia 1926
Brooks, Mrs. Wm. F., 48 High St., New Britain, Conn. 1908
Brown, Miss Bertha M., 10 Greenman Ave., Westerly, R. I. 1921
Brown, Hubert H., 158 Glebeholm Blvd., Toronto, Canada 1926
Buffington, Charles S., 963 East Sixth St., Inglewood, Cal. 1928
Burgin, Herman, M.D., 204 W. Rittenhouse St., Germantown, Philadelphia, Pa. 1915
Burnham, Stewart Henry, Dept. Botany, College of Agriculture, Ithaca, N. Y. 1897
Burrage, Albert C., 85 Ames Bldg., Boston, Mass. 1921
Butters, Prof. Frederic K., University of Minnesota, Minneapolis, Minn. 1917
Campbell, Dr. Douglas Houghton, Leland Stanford University, Palo Alto, Cal. 1915
†Capp, Seth Bunker, P. O. Box 2054, Philadelphia, Pa. 1915
Carhart, Macy, 1462 Morada Place, Pasadena, Cal. 1915
Carlisle, Morten, 71 E. Hollister St., Cincinnati, Ohio 1928
Carpenter, Dana S., Middletown Springs, Vt. 1926
Cheever, Dr. Austin Walter, 203 Clinton Rd., Brookline, Mass. 1911
Cheney, Prof. Ralph H., New York University, Washington Square, New York, N. Y. 1925
Child, Mrs. H. W., 186 Commonwealth Ave., Boston, Mass. 1915
Child, W. A., 389 Hess St., South Hamilton, Ontario 1917
Chisholm, Mrs. Maud L., Procter, Vt. 1923
Choate, Miss Alice D., Lesone Hotel, 5002 Waterman Ave., St. Louis, Mo. 1898
‡Christensen, Dr. Carl, Botanical Museum, Copenhagen, Denmark 1915
Chubbuck, Mrs. Edwin J., 2922 Forest Ave., Berkeley, Cal. 1927
Clark, Mrs. P. B., 171 Marlboro St., Boston, Mass. 1928
Clarkson, E. H., 41 Tyng St., Newburyport, Mass. 1917
Clayton, Ernest, 434 Laurel St., San Anselmo, Marin Co., Cal. 1928
*Clute, Prof. Willard Nelson, Butler University, Indianapolis, Indiana 1893
Cook, Mrs. Helen Newman, 201 Longwood Rd., Roland Park, Baltimore, Md. 1927
Corne, Miss F. E., Suite 407, Craigie Hall, University Road, Cambridge, Mass. 1910
Cornman, Mrs. L. R., 511 N Ave., Los Angeles, Cal. 1917
Cowan, Alexander, Valleyfield, Penicuik, Midlothian, Scotland 1914
Cromwell, Miss Mary L., 198 Flax Hill Rd., South Norwalk, Conn. 1926
Dacy, Miss Alice Evelyn, 98 Hemenway St., Boston, Mass. 1898
Dane, Mrs. Ernest B., Roughwood, Chestnut Hill, Mass. 1925
Darling, Miss Nancy, Sky Farm, R. D. No. 2, Woodstock, Vt. 1909
Davenport, Mrs. Elizabeth Braxton, 46 Western Ave., Brattleboro, Vt. 1901
Davis, Edward E., Norwich, N. Y. 1928
Davis, Wm. Anthony, West Barrington, R. I. 1927
Dawes, Miss Emily M., Marlboro, N. H. 1927
Deam, Charles Clemon, R. D. No. 6, Bluffton, Ind. 1905
Deane, Walter, 29 Brewster St., Cambridge, Mass. 1911
Delafield, Mrs. John P., 17 East 79th St., New York, N. Y. 1923
Demaree, Delzie, Dept. Botany, University of Arkansas, Fayetteville, Ark. 1928
Demetrio, Rev. C. H., 1202 Azalia St., Memphis, Tenn. 1900

Dobbie, H. B., 84 Market Rd., Epsom, Auckland, New Zealand 1926
Dobbins, R. A., Ohio Northern University, Ada, Ohio 1927
Dole, W. Herbert, 23 Overlook Ave., West Orange, N. J. 1926
Doubleday, Florence F. (Mrs. Arthur W.), Woodstock, Vt. 1928
Dowell, Dr. Philip, Port Richmond, N. Y. 1906
Dubois, Mrs. Louis J., 1394 Dean St., Brooklyn, N. Y. 1927
Duncan, Robert, 136 Woodland Rd., Chestnut Hill, Mass. 1927
Dunn, Mrs. Cleveland A., Armarestra, Sherbrooke Rd., Scarsdale, N. Y. 1927
Durand, Herbert, Crow's Nest Wood, Bronxville, Westchester Co., N. Y. 1924
Eames, Mrs. Edward A., 155 Bryant St., Buffalo, N. Y. 1918
Earle, Mr. R. S., 350 Commonwealth Ave., Boston, Mass. 1928
Eaton, Prof. E. H., 678 Main St., Geneva, N. Y. 1927
Eaton, Frederick W., Concord, Mass. 1921
Edson, Mrs. Josephine Z., 54 Fairview Ave., Rochester, N. Y. 1928
Eggleston, Willard Webster, U. S. Department of Agriculture, Washington, D. C. 1911
Emmons, Edwin Thayles, Geneva, N. Y. 1915
Evans, Mrs. Edw. W., 6014 Chew St., Germantown, Philadelphia Pa. 1927
Evans, Miss Mary, Haverford, Pa. 1927
Farwell, Oliver Atkins, 271 Smith Ave., Detroit, Mich. 1913
Fay, Mrs. Dudley Ward (Aimie B.), 63 South St., Auburn, N. Y. 1926
Fazio, Mrs. Ernest, West Grove, Pa. 1924
Featherly, H. I., Dept. of Botany, Oklahoma Agric. and Mechan. College, Stillwater, Okla. 1928
Fedtschenko, Prof. Boris, Jardin Botanique Principal, Leningrad, U. S. S. R. 1927
Ferguson, William C., 37 Atlantic Ave., Hempstead, N. Y. 1920
Finegan, Mrs. Thomas C. (Grace B.), 26 Strathallan Park, Rochester, N. Y. 1925
Fisher, George L., 610 Hadley Ave., Houston, Texas 1923
Flett, J. B., 7563 19th Ave., S. W., Seattle, Wash. 1899
Flint, Mrs. Elizabeth, Penryn, Placer Co., Col. 1925
Floyd, Fred Gillan, Hingham, Mass. 1897
Foote, Mrs. E. M. (Caroline C.), 119 East 40th St., New York, N. Y. 1925
Forbes, Fayette Frederick, Brookline, Mass. 1911
Fox, Mrs. Joseph M., 7913 Crefeldt St., Chestnut Hill, Philadelphia, Pa. 1927
Freedley, Miss Anna B., 15 West 51st St., New York, N. Y. 1928
Gannett, L. S., 64 Poplar St., Brooklyn, N. Y. 1928
Gaylord, Mrs. Ilsien Nathalie, Hotel Gralyn, 20 Charlesgate West, Boston, Mass. 1924
Geske, E. J., P. O. Box 3733, West Palm Beach, Fla. 1924
Gilmore, Mrs. Elizabeth, 125 S. Whitney Ave., Youngstown, Ohio 1923
Golding, Mrs. Ada, Mill River, Mass. 1925
Goodale, Prof. Alfred S., Dept. Botany, Amherst College, Amherst, Mass. 1921
Gordon, Miss Sue S., Livermore, Maine 1926
Graves, Edward W., Bentonsport, Iowa 1917
Gray, Rev. Frederick W., Cass, W. Va. 1923

Greene, F. C., 1434 S. Cincinnati Ave., Tulsa, Okla. 1913
Grout, Dr. Abel Joel, 1 Vine St., New Brighton, Staten Island, N. Y. 1910
Grubb, Prof. Percy Lamar, 417 Briggs St., Harrisburg, Pa. 1905
†Gruber, C. L., Kutztown, Pa. 1907
Haas, Dr. Flora Anderson, 736 East 3rd St., Bloomington, Ind. 1917
Hall, Mrs. Carlotta C., 1633 La Loma Ave., Berkeley, Cal. 1913
Halsey, Miss Alice, Garrison-on-Hudson, N. Y. 1923
Halsey, Harold V. W., 957 Boulevard, Astoria, Long Island, N. Y. 1921
Harper, Prof. Robert Almer, Columbia University, New York, N. Y. 1913
Harrington, Mrs. Melvin H., 1016 Westview St., Mt. Airy, Philadelphia, Pa. 1927
Hart, Bertrand K., 32 Dudley St., Fall River, Mass. 1928
Hartline, Mrs. D. S., State Normal School, Bloomsburg, Pa. 1910
Hazen, Edwin Humphrey, 373 Crown St., New Haven, Conn. 1923
Hazen, Dr. Tracy Elliot, Columbia University, New York, N. Y. 1910
Heermance, Miss Laura W., 354 Edward St., New Haven, Conn. 1923
Hendee, U. G., Route 2, Box 134, Tucson, Arizona 1928
Hensley, J. D., 240 Forsythe St., Beaumont, Texas 1925
Hewitt, Mrs. Judith D., 308 West 82nd St., New York, N. Y. 1926
Hobbs, Mrs. John E., 2933 Whitney Ave., Mount Carmel, Conn. 1927
Holtzoff, Mrs. Mary, 163 West 128th St., New York, N. Y. 1917
Hopkins, Prof. Lewis S., Culver-Stockton College, Canton, Mo. 1905
House, Dr. Homer Dolliver, Education Bldg., Albany, N. Y. 1918
Howe, Dr. Marshall Avery, New York Botanical Garden, New York, N. Y. 1911
Huber, F. F., Farmers' National Bank, Pennsburg, Pa. 1926
Humphrey, George Scranton, 27 Pine St., New York, N. Y. 1911
Hunnewell, Francis Welles, 2nd., 5 University Hall, Cambridge, Mass. 1915
Hunter, Dr. Mabel R., Glenville High School, Cleveland, Ohio 1925
Hutchinson, Mrs. Susan W., 724 So. Orange Drive, Los Angeles, Cal. 1923
James, Mrs. Walter B., 7 East 70th St., New York, N. Y. 1921
Jayne, Miss Addie, Hampton Institute, Va. 1925
Jenks, Charles William, Stonecroft Farm, Bedford, Mass. 1908
Jennings, Dr. Otto Emery, Carnegie Museum, Pittsburgh, Pa. 1911
Johnson, Frank W., 1362 Amherst St., Buffalo, N. Y. 1925
Jones, Rodney Wilcox, 100 Broadview Ave., New Rochelle, N. Y. 1927
Jurica, Hilary S., St. Procopius College, Lisle, Ill. 1919
Kamm, Mrs. Oliver (Minnie W.), 571 Washington Rd., Grosse Pointe, Mich. 1922
Kaufman, Miss Pauline, 83 Argyle Ave., New Rochelle, N. Y. 1900
Keeler, Mrs. L. M., P. O. Box 473, Searsdale, N. Y. 1913
Kelsey, Harlan P., 209A Washington St., Salem, Mass. 1921
Kelton, Mrs. George H. (Ruth C.), Hubbardston, Mass. 1926
Kestner, M. Paul, Le Clos Etoilé, Chaiely Village, Lausanne, Switzerland 1928
†Kidder, Nathaniel T., Milton, Mass. 1921
Killip, Ellsworth P., U. S. National Museum, Washington, D. C. 1916
Kimball, Miss Laura F., Box 50, R. Route No. 1, National City, San Diego Co., Cal. 1897
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American Fern Journal

Vol. 19 APRIL–JUNE, 1929 No. 2

The Ferns of Crater Lake National Park

F. Lyle Wynd

The ferns of Crater Lake have been very much overlooked by botanists in the past. This may have been due to the fact that the region is somewhat difficult to explore, and that a permanent camp is inconvenient to maintain; and then also even botanists are often in a hurry, and in the few days of a summer's vacation they naturally discover only the more obvious species.

The check list of the ferns of Crater Lake National Park which is herewith submitted is based upon three seasons of continuous field work is this region. That it is complete is scarcely to be hoped, but it will serve to change the popular impression that only pines and sedges grow there.

The synonymy given is not intended to be even remotely complete, the object being only to include those citations than the amateur botanist would be likely to meet in studying the ferns of the territory covered by this list. Perhaps when the botanical millennium dawns it will not be necessary for students to wade through the present maze of technical terms.

OPHIOGLOSSACEAE

Botrychium pumicola Coville in Underw. Nat. Ferns ed. 6: 69. 1900.

Oregon Moon-wort.

The name of this plant means that the plant lives on

[Volume 19, No. 1 of the Journal, pages 1–36, figs. 1 and 2, was issued February 10, 1929.]

the pumice. It is extremely rare, having been collected but twice. One must look carefully indeed if he aspires to find this small, inconspicuous relative of the ferns. Its color blends so well that it almost defies detection, and well it is that this is so for certainly it would become extinct in a short time were it at all conspicuous in a land of tourists and pleasure seekers.

POLYPODIACEAE

FILIX FRAGILIS (L.) Gilib. Exerc. Phyt. 558. 1792.
(*Polypodium fragile* L. Sp. Pl. 1091. 1753)
(*Cystopteris fragilis* Bernh. Schrad. Neues Journ. Bot. 1:27, pl. 2, f. 9. 1806)
Brittle Fern.

This delicate little fern, which is one of the most widely distributed over the world of all ferns, likes to grow at the base and on the sides of moist cliffs. The leaves are very variable, Milde giving seventeen forms and varieties. On the Pacific Coast only the specific form is recognized.

POLYSTICHUM SCOPULINUM (D. C. Eaton) Maxon, Fern Bull. 8: 29. 1900.
(*Aspidium aculeatum scopulinum* D. C. Eaton, Ferns N. A. 2: 125. 1880)
Eaton's Shield-Fern.

The dry rocks and ridges are the habitat of this species, but it does not refuse to grow in moist shady places. The pinnules of the lower pinnae are better developed when the plant grows in a moist and shady locality.

POLYSTICHUM LONCHITIS (L.) Roth, Röm. Arch. Bot. 2: 106. 1799.
(*Polypodium lonchitis* L. Sp. Pl. 1088. 1753)
(*Aspidium lonchitis* Swartz, Journ. Bot. Schrad. 1800: 30. 1801)
Holly Fern.

The casual passer-by might easily mistake the Holly Fern to be the more common Sword Fern of the lower altitudes, but the triangular lower pinnae of the Holly Fern easily distinguish it from others which resemble it in this region.

POLYSTICHUM MUNITUM IMBRICANS (D. C. Eaton) Maxon, Fern Bull. **8**: 30. 1900.
(*Aspidium munitum imbricans* D. C. Eaton, Ferns N. Am. **1**: 188. pl. 25, f. 3. 1878)
Imbricated Sword Fern.

This resembles the true Sword Fern but is smaller and the pinnae are inclined upwards, making an angle of 45 degrees with the rachis. It grades gradually into the typical form but appears fairly distinct from it in the Crater Lake territory.

ATHYRIUM FILIX-FOEMINA (L.) Roth, Röm. Arch. Bot. **2**: 106. 1799.
(*Polypodium filix-foemina* L. Sp. Pl. 1090. 1753)
(*Athyrium cyclosorum* Rupr. Beitr. Pflanzenk. Russ. Reich. **3**: 41. 1845)
(*Athyrium filix-foemina californicum* Butters, Rhodora, **19**: 201. 1918)
Lady Fern.

This is a tall and very beautiful species which inhabits the moist canyon floors. Some botanists separate this form from *Athyrium cyclosorum*, saying that our western type is the latter, while typical *A. filix-foemina* is a more eastern form. But when the Doctors disagree one may take his choice.

CRYPTOGRAMMA ACROSTICHOIDES R. Br., Bot. App. in Franklin's Narr. of a Journey to the Shores of the Polar Sea. 367. 1823.
(*Cryptogramma crispa* var. *Americana* Hook. Sp. Fil. **2**: 130. 1858)
(*Allosorus acrostichoides* Sprengel, Syst. **4**: 66. 1827)
(*Allosorus crispus acrostichoides* (R. Br.) Milde, Fil. Eur. et Atlant. 24. 1867)
American Rock-Brake.

Botanists have had a hectic time of it trying to decide what to call this plant. Its complete synonymy is staggering to a beginner. But whatever it is called, it is a beautiful little fern growing up among the rocky cliffs.

PTERIDIUM AQUILINUM PUBESCENS Underw., Nat. Ferns, ed. 6, 91. 1900.
(*Pteris aquilina pubescens* (Underw.) Clute, Fern Bull. **15**: 124. 1907)
(*Pteris feei* Schaffn.; Fée, Mém. Foug. **8**: 73. 1857)
(*Pteris aquilina lanuginosa* Bong. Mem. Acad. St. Petersb. VI. **2**: 176. 1832)
Western Bracken.

This plant is almost omnipresent. It grows in almost any sort of habitat, and in some form or other occurs over most of the earth. We have tried to prepare edible dishes of the tender young stems of the spring shoots, but none of the many published recipes came up to our expectations. The Japanese do, however, eat it regularly.

CHEILANTHES GRACILLIMA Eaton, Bot. Mex. Bound. 234. 1859.
Lace Fern.

Wherever there are high cliffs or ridges of exposed rocks one is likely to find the Lace Fern growing in dense tufts in the crevices. Its roots go down so far between the rocks that often it is impossible to collect the specimen in perfect condition.

To identify it positively one must see the minute forked hairs or scales on the upper side of the leaves. This is only to be done with a good glass or microscope. However, no close relative of it has been found in this region and this makes the task of identifying it much simpler.

PELLAEA DENSA (Brack.) Hook. Sp. Fil. 2: 150. pl. 125. B. 1858.

(*Onychium densum* Brack. in Wilkes, U. S. Exped. 16:120. 1854)
(*Cryptogramma densa* Diels, in Eng. and Prantl, Pflanzenfam. III, pt. 2: A:280. 1899)
(*Cheilanthes siliquosa* Maxon, Am. Fern Journ. 8: 116. 1918)
(not *Cheilanthes densa* Fée, Gen. Fil. 156. 1850–1852)

This plant resembles the American Rock Brake in general appearance, but its brown stipes will distinguish it from any other species in the park.

Mr. L. F. Henderson, that veteran botanist of the Cascade Mountains, contributed much valuable assistance in the determination of certain of the above species, and Charles A. Weatherby was kind enough to look up the original authors and citations of some of the more obscure synonyms.

EUGENE, OREGON

A Forest of Forked Tree Ferns

H. B. DOBBIE

Hitherto I had looked upon a forked or branched tree fern as something very rare, unusual, abnormal. On one occasion only had I come across the phenomenon—a mamaku with three heads on the Mere-mere road near Opetiki. I was, therefore, more than surprised to find in the bush near Tauranga many examples of this exceptional growth, and not in one locality only, but in situations twenty and thirty miles apart. The botanical works I have consulted mention this branching habit as not uncommon in *Hemitelia Smithii* and *Dicksonia squarrosa*, but do not mention it in *D. fibrosa*, and this is the tree fern I often saw forked. I measured one that had been cut down, twenty-seven feet high with seven forks. The

stems usually diverge at an acute angle and then grow up nearly parallel, with the crowns on a level. In several localities I found it was the rule and not the exception for *D. squarrosa* and *D. fibrosa* to have forked stems.

Mr. C. Cameron, of Tauranga, who first showed me these forked tree ferns, and his party took me to one such forest on the Pye's pa road some thirty or forty miles from Tauranga, in February, 1928, where I made a systematic examination of the trees. Taking a monster *Dicksonia squarrosa* as the center I counted the tree

A GROVE OF FORKED DICKSONIA FIBROSA AT THE EDGE OF THE FOREST

ferns for about thirty yards on each side. There were 67, 15 of which had single stems and 52 were forked. In these 52 there were a total of 227 forks, an average of four forks to each. Some had 2, 3, 4, 5, 8, 15, and, finally, the monster had 19 forks.

So determined was Mr. Cameron to get a good photograph of this prodigy that he cut down a wide space of tree ferns and bushes, and the result has more than fulfilled my expectations. The fern measured 21 feet to the

top of the fronds, four feet in circumference two feet above the ground and seven feet in circumference above where the forking began, five feet up.

I find the following allusions to branching tree ferns. In Mr. T. F. Cheeseman's Flora occur these passages. Page 951, first edition, under *Hemitelia Smithii*: "The trunk is not uncommonly forked or branched above; a Mr. Buchanan (Trans. N. Z. Institute, XIX, 217) describes a remarkable specimen which has no less than 16 well-developed branches." Page 953, under *Dicksonia squarrosa*: "The trunk is occasionally branched and sometimes produces adventitious buds along its whole length, crowned with miniature fronds."

In Mr. Field's "Ferns of New Zealand" occurs the following passage under *Hemitelia Smithii*: "Near Dunedin examples of this form with branched caudices are common. One on Mt. Carghill has sixteen branches."

Mr. J. W. Brame, of Auckland, an undoubted authority on our ferns, has given me the following particulars in a letter. "At Opua, Taranski, in 1897 there were two plants (*Dicksonia squarrosa*), one of which had seven and the other five branched caudices, each branch bearing a crown of fronds. *Cyathea dealbata.* T. Urk recorded a plant of this species having a dichotomously forked caudex producing four crowns.—Trans. N. Z. Inst., V, 347. *Cyathea medullaris.* A plant of this species growing at Otira in 1923 had six branches at the top of the caudex, each branch having a well developed crown of fronds. Your finding so large a number of plants of *Dicksonia squarrosa* and *D. fibrosa* having the peculiarity of branched caudices and scattered over so wide an area leads to the conclusion that they have been derived from a parent plant and is suggestive of a perpetuation of an abnormality to the extent perhaps of varietal development. This is worth consideration."

Possibly there are other forests in New Zealand of many-headed monsters, but I have not heard of them. Now that attention has been called to the subject I am in hopes of obtaining such information. Had it not been for the enterprise of Mr. Cameron I should not have seen those round Tauranga.

AUCKLAND, NEW ZEALAND

New Tropical American Ferns.—VI.[1]

WILLIAM R. MAXON

The following three new ferns are from British Guiana, Panama, and Hispaniola, respectively. The last is described at the request of Dr. Carl Christensen, who is preparing a report upon the recent large collections obtained by Dr. E. L. Ekman in Hispaniola, chiefly in the Republic of Haiti.

Hemitelia superba (Jenm.) Maxon, sp. nov.

Arborescent. Fronds ample, the blades 1.3–1.5 meters broad, quite tripinnate as to the basal parts of the secondary pinnae; primary pinnae ovate-oblong, acuminate, 65–75 cm. long, 25–32 cm. broad, petiolate (3.5 cm. or more), the rachis brown, sulcate, densely hirsute-strigose above, deciduously paleaceous beneath, the scales 3–5 mm. long, lance-attenuate, flexuous, bright brown, rigidly ciliate-fimbriate; secondary pinnae (pinnules) about 18 pairs below the pinnatifid tip, distant, those of the basal half subequal, narrowly oblong, short-petiolate (2–4 mm.), 13–16 cm. long, 3–4 cm. broad, slightly reduced at the base, gradually narrowed from the middle to a long-acuminate apex (the tip subentire), the rachis obscurely alate at base, widely so distally, paleaceous like the secondary rachis; main segments about 15 pairs, distant, oblong, broadest at or just above the middle,

[1] Published by permission of the Secretary of the Smithsonian Institution.

rounded-obtuse at apex, ciliate, those of the lower half of the pinnule constricted to a rounded base, sessile or slightly adnate, deeply crenate-serrate or lobed, those above sharply and narrowly decurrent, connected by an expanding wing; midvein minutely appressed-paleaceous beneath, above sparsely hirsute; veins about 10 pairs, prominent, free, very sparsely hirsute above, nearly glabrous beneath, those of the larger lobes or crenations with 2 pairs of subpinnately arranged branches, the basal pair often both fertile; sori 12–15 on each side of the midvein, borne in a close row about half-way to the margin; indusium shallow, usually bilobate, not wholly proximal, ciliate.

Type in the U. S. National Herbarium, no. 1,120,118, collected in the region of Mount Raywa, British Guiana, by G. S. Jenman; received from the Botanic Gardens, Georgetown, British Guiana.

The present specimen, labeled in Jenman's hand *Hemitelia multiflora* R. Br. var. *superba* Jenm., is presumably a part of the original collection described by Jenman[2] under this name; but the writer has shown[3] that *Hemitelia multiflora* (J. E. Sm.) R. Br. is in reality a widely different species of Central America and Panama described later as *H. nigricans* Presl, under which name it has commonly been known. Aside from the present plant the forms which Jenman included in his erroneous concept of *H. multiflora* are now referred to *H. guianensis* Hook. and *H. Parkeri* Hook., of Trinidad and the Guianas, from both of which species *H. superba* is obviously distinct. Of the "varieties" known to him Jenmen refers to it as "a magnificent plant, and the largest and most distant from the type." He mentions no intermediate states connecting it with the plants we now call *H. Parkeri* and *H. guianensis*, and certainly none have

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[2] Ferns Brit. W. Ind. Guian. 47. 1898.

[3] Bull. Torrey Club 38: 545–550, *pl. 35*. 1912; Contr. U. S. Nat. Herb. 17: 418, 419. 1914.

been seen by the writer. The huge size, tripinnate condition, and distant, often free segments serve to distinguish it readily; in vestiture it approaches neither species very closely.

Asplenium psilacrum Maxon, sp. nov.

Rhizome erect, 2–4 cm. long, about 1 cm. thick, long-radicose on all sides, the exposed crown densely paleaceous; scales 3.5–4 mm. long, 0.5 mm. broad at base, tapering to a long-attenuate apex, brown in mass, the margins yellowish, composed of much smaller cells. Fronds several, fasciculate, nearly exstipitate, the stipe about 1 cm. long, stout, terete, purplish brown, glabrescent, with a few basal scales; blades nearly linear, simply pinnate, 30–40 cm. long, 3.2–4 cm. broad at middle, gradually attenuate to the very narrow base (5 mm. broad), abruptly acutish at apex, the rachis brown, sublustrous, very narrowly greenish-marginate in the upper part, produced into a slender curved naked greenish flagellum (6–10 cm. long), proliferous at tip; pinnae 35–38 pairs, horizontal, nearly equal (excepting the uppermost and those of the basal third), sessile, mostly oblong, 1.5–2 cm. long, 7–9 mm. broad, subrectangular at the inequilateral base (the distal inner margin parallel to the rachis, the proximal oblique), subauriculate (the lobe rounded-obtuse, entire, extending nearly half-way to the costa), beyond this deeply crenate to the broad rounded-obtuse apex, the crenations 5 or 6 on each side; costa nearly percurrent, medial except in the basal part, prominulous above, concealed beneath, delicate, subflexuous; veins 6 or 7 pairs, those of the basal lobe sterile, once or twice forked, the others almost invariably simple, arcuate, ending in an elongate hydathode rather remote from the margin; sori 3–5 pairs, linear, arcuate, 3–4 mm. long; indusium firm, whitish, about 5 mm. broad, soon revolute and discolored. Leaf tissue dark green, firmly herbaceous, semitranslucent, glabrous.

Type in the U. S. National Herbarium, no. 579,206, collected in the vicinity of Cana, Panama, April 20, 1908, by R. S. Williams (no. 913). Known otherwise from imperfect specimens collected on Mount Pirri,

Province of Panama, Panama, at an altitude of 1,500 meters, April 30, 1912, by E. A. Goldman.

Asplenium psilacrum is related to *A. oblongatum* Mett.,[4] *A. Hallii* Hook.,[5] and *A. Spruceanum* Hieron.,[6] of the South American Andean region, all of which have remarkably short, ebeneous stipes. The two last are notably distinct, however, in their membranous leaf tissue, in their strongly auriculate, pectinately pinnatifid pinnae, and in having the blades long-attenuate at apex, the reduced upper pinnae numerous and finally minute; naked flagelliform tip very short or sometimes wanting.

Asplenium oblongatum, which was erroneously reduced to *A. cyrtopteron* Kunze by Hieronymus,[7] is more closely related to *A. psilacrum*, differing in its much greater size, distinctly membranous leaf tissue, broadly lobed pinnae, and very oblique, greatly elongate sori, and particularly in having the veins once or twice forked. It differs from all three species in having the pinnae nearly equilateral, *i.e.* not excised at lower base.

Polystichum spongiosum Maxon, sp. nov.

Rhizome stout, suberect, woody, 2 cm. thick or more, densely paleaceous, the scales tufted-imbricate, mostly ovate, long-acuminate and hair-pointed, about 9 mm. long, light castaneous, thin, flattish or convex. Fronds numerous, cespitose, erect-arching, not proliferous, 30–50 cm. long, conform; stipes as long as the blade, slender (1–1.5 mm.), stramineous, sulcate anteriorly, deciduously paleaceous; blades pinnate, narrowly linear-oblong, mostly 15–25 cm. long, 3.5–5 cm. broad in the basal two-thirds, evenly narrowed upward to the acuminate lobate tip; rachis stramineous, subpersistently paleaceous, the scales linear-filiform, flexuous, dark, hair-pointed; pin-

[4] Linnaea **36**: 97. 1869.

[5] Sp. Fil. 3: 202. 1860; Second Cent. Ferns, *pl. 30*. 1861.

[6] Hedwigia **60**: 260. 1918.

[7] Hedwigia **61**: 31. 1919.

nae about 15 pairs, alternate, subdistant (the lower ones distant), horizontal, inequilateral, bluntly semihastate to subtrapeziform-oblong, roundish at apex, excavate or broadly cuneate at lower base, rounded-rectangular or broadly auriculate above, elsewhere subentire to broadly crenate, invariably non-spinulose, the largest 2.5 cm. long, 1.5 cm. broad just above the base, sessile, or the basal ones petiolulate; leaf tissue spongiose, subcorrugate (the veins wholly concealed), paleaceous, the scales remote, small, filiform from an expanded substellate base; sori 3–6 pairs, very large, medial, distant; indusia firm, coarsely erose, deciduous or subpersistent.

Type in the U. S. National Herbarium, no. 1,411,237, collected at the summit of Massif de la Selle, Haiti, altitude 2,800 meters, February 2, 1925, by E. L. Ekman (no. H.3173). Specimens collected by Dr. Ekman at the same time and place, but at a slightly lower altitude, were sent to Dr. Christensen as nos. 3173a and 3173b.

A singular species, in its non-spinulose character not very closely related to *P. echinatum* (Gmel.) C. Chr., which is the plant usually known erroneously as *P. triangulum* (L.) Fée.[8] In its thick leaf tissue and long-stipitate fronds it recalls *P. Underwoodii* Maxon, a rare high mountain plant of Jamaica; but that is a species with mostly dark lustrous rhizome scales, narrowly triangular blades, pinnae mucronate at apex, and the attenuate foliaceous apex of the blade deeply retuse at the tip and there proliferous.

WASHINGTON, D. C.

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[8] See, Journ. Wash. Acad. Sci. 18: 582–586, *fig. 1.* 1928.

Ferns by the Georgian Bay

W. E. Saunders

Owen Sound has long had an outstanding reputation as a location for rare ferns and that is the writer's excuse for this endeavor to clutter up the pages of our Journal with some remarks on a trip to that region.

It must be thirty-five years since Dr. J. Scott, of Southampton, Ontario, published his find of *Asplenium Ruta-muraria* on Flowerpot Island. This island is two miles off the head of the Bruce Peninsula, which is the finger that separates the Georgian Bay from Lake Huron, and which reaches out to within twenty or thirty miles of Manitoulin Island. Ever since then the writer has dreamt of a trip to find that little rarity. On reaching Tobermory on September 1 our spirits sank into our boots when the residents told us of the ferns in the caves on Flowerpot and of how the visitors to the island carried them away. We envisioned the destruction of *Ruta-muraria* and it was with rather doleful feelings that we approached the caves after landing on the island on September 2. Our relief may be imagined when we found that the caves were inhabited with nothing other than large quantities of *Cystopteris bulbifera*—the very weediest fern that the gardener ever attempts.

After visiting the caves the walk along the cliff base was the next thing on the program. The cliffs—about two hundred feet high—surround the island, and although they are broken by a gentle slope in the middle of each side, the general appearance of the island is that of abrupt cliffs not many feet back from the water's edge. Large rocks have at times fallen from the cliffs and lie in confusion at their base. Among these rocks trees have sprung up and provided the necessary shade in which grows much moss and very many ferns. The

most abundant ferns on the island after *Crystopteris bulbifera* are *Asplenium Trichomanes* and *Pellaea gracilis* and after them come *Asplenium viride* and *A. Ruta-muraria*, in the order named but near each other in relative abundance. The last was not found on the rocks near the water, but a part of the island has two series of cliffs and it was on the fallen rocks from the upper series which lie from one to three hundred yards back from the water that we found the object of our hunt. We explored only two out of four rocky corners of the island and *Ruta-muraria* was found on the southeast one only. We found ten or fifteen patches of it containing five to twenty-five groups in each patch. All of them were on the sides of fallen rocks growing among moss.

One strange thing about the island is that, although *Aspidium Lonchitis* is an abundant fern on the way up the peninsula, yet it does not occur on the island itself.

A complete list of the ferns observed follows and is arranged in the order of abundance:

Cystopteris bulbifera
Asplenium Trichomanes
Cystopteris fragilis
Pellaea gracilis
Asplenium Ruta-muraria
Asplenium viride
Aspidium marginale
Botrychium virginianum
Aspidium spinulosum

As we went home we drove by way of Owen Sound, where we called on Mr. W. R. McColl, who has studied the ferns of the region for many years and who told us of a patch of *Asplenium ebeneum* which we had driven by, in ignorance of its existence. After a pleasant visit with him during which he showed us pressed fronds of his latest pet—a beautiful crested *Asplenium thelypteroides*—we went for a short visit to the base of the cliffs at the Rifle Range where we found quantities of *Scolopendrium*, *Aspidium Lonchitis*, *A. Filix-mas* and a few

A. Goldianum, all of them to be found within fifty yards of each other.

Scolopendrium was, as always, one of the objects of the journey and we were much pleased when we found it as far up the peninsula as twenty miles beyond Wiarton. How far it spreads to the east of Owen Sound I cannot say, but in driving along the beautiful road which edges the peninsula between Owen Sound and Wiarton we found it in the only woods we entered and there is little doubt that it is extensively present for at least ten miles east of Owen Sound and thirty or forty miles northwest.

LONDON, ONTARIO.

Ferns of New Zealand

J. W. BRAME

Pteridologists, after exhausting their own districts, naturally turn to other localities and perhaps distant countries for further knowledge of ferns. With this in mind it occurred to me that readers of the AMERICAN FERN JOURNAL might appreciate a few words about a country that is almost farthest south—New Zealand—and its ferns. But it is as well first to describe the whereabouts on the map of this Dominion. Briefly and approximately New Zealand consists of two main and one smaller islands—North Island, South Island, and Stewart Island—with numerous outliers, and lies between the 34th and 40th parallels of south latitude across the mean meridian of 172° 30′ of east longitude, running in a N.N.E.–S.S.W. direction, about 1,200 miles east of Australia, with the east coast of which it is nearly parallel. The North Island contains 44,468 square miles of territory, the South Island 58,525 square miles, and

Stewart Island 665 square miles. The total length is about 1,000 miles, the greatest breadth 280 miles, and the smallest only a mile or two, so that the average width may be 60 to 80 miles. In this, to American readers, small area may be found one of the largest and most varied assemblages of ferns and allied plants recorded in any similar area in the world; indeed someone once suggested the country should be called "Filicia"—Fernland.

The New Zealand Botanical Region takes in a number of distant islands, but only about ten species of ferns indigenous in that Region are not found in New Zealand proper.

The once luxuriant forests of this country are fast vanishing before advancing civilization, so that with trees, shrubs, and other flowering plants the ferns are disappearing, and in a few years many will be remembered by name only except, of course, where preserved in collections; even now some are hardly procurable, having gone from localities in which they were plentiful. This although regrettable is unavoidable, grass being of more value to the farmer than are ferns and trees.

As in other countries many New Zealand ferns are local in habitat, and some vary in range from sea-level to about 6,000 feet altitude, that is, from littorals exposed to sea-spray to alpines growing close to perpetual snow.

It is not possible to state exactly the actual number of indigenous ferns and allied plants found in this country so diverse are the opinions of botanists, but it may be said with a near approach to accuracy that there are recognized in the New Zealand Region of Filices 141 species and eighteen varieties, and of other orders seventeen species and one variety. If, say, three hitherto un-

recognized species may be included it will bring the number to 180, and if from this number are deducted ten found in the distant islands the total for New Zealand proper (including Chatham Islands, 536 miles east of the South Island) will be about 170, all included in fifty-three genera. Of these genera *Hymenophyllum* comes first with twenty species and two varieties, *Blechnum* (*Lomaria*) has fourteen species and one variety, *Asplenium* thirteen species and five varieties, and of *Lycopodiaceae* there are eleven species and one variety. Twenty genera are represented by one species each, and of one genus there is only a variety. The total endemics are about forty-two. These figures are perhaps not quite accurate for the reason already given but will be near enough to show the abundance in this section of the botanical world represented in this small area. It is curious to note in this connection that *Equisetum* is not recorded as found in New Zealand.

Most of these ferns grow in the forests (locally called "the bush"), many of them being epiphytes, others terrestrial among mosses and the decayed vegetable material of damp forest floors, others again are to be found luxuriating as rupestrals upon the rocky sea-cliffs of the coast, almost soilless lava beds, limestone and other sedimentary rocks. In deep, damp gullies upon banks of streams many species live and thrive, while others grow under favorable conditions beside country road and mountain path. In the North and part of the South Islands rolling hills are covered and hollows filled with dense masses of *Pteridium aquilinum* var. *esculenta*, the edible rhizomes of which formed a principal article of food for the Maori people before the white man introduced flour. They also used similarly the sub-aerial rhizomes of *Marattia fraxinea*. *Blechnum* (*Lomaria*)

capense in its larger or smaller forms grows almost everywhere, being found in marshes, on banks and cliffs, on level ground by the roadside, among *Pteridium* and *Leptospermum*, anywhere in fact that it can find sufficient soil for support, and in some places where there is very little soil. The fronds of this species vary in length from about twelve inches to five or six feet and in width from a few to ten or fifteen inches at the middle. There are several fairly distinct varieties. It is not certain that this species is identical with that of South Africa. *Histiopteris incisa*, and *Paesia scaberula* in some places overrun considerable areas. In the forests many ferns grow as epiphytes, such as *Hymenophyllum*, *Trichomanes*, *Asplenium*, *Blechnum*, etc., some trees being clothed from base to summit with those that live among the mosses, etc.

New Zealand is rich in tree-ferns, having ten species, namely, *Dicksonia* three, *Cyathea* five (two of these grow in distant islands), *Hemitelia* one (this one also grows in the Auckland Islands, the most southerly habitat of arborescent ferns, 200 miles south of New Zealand), and *Alsophila* one species.

Freak or abnormal forms are not uncommon. My notes record at least sixty-five of our 170 ferns as having developed peculiarities in the shape of double fronds (bifid rachis or stipe), forked terminal and lateral pinnae, crested apices, fimbriate lateral and terminal cresting, and in tree-ferns branched caudices, each branch producing a perfect crown of fronds, natural developments and in no way growths after injury. There is in this country one fern, *Asplenium flabellifolium*, that often takes root at the tips of the fronds and then produces new plants. Another peculiarity has been noticed in connection with *Asplenium flaccidum* which occasion-

ally produces bulbils on both epiphyte and terrestrial plants, although it is rarely bulbiferous like *Asplenium bulbiferum* that produces these curious bud-like growths from parts of the frond as well as the usual spores. Further these bulbils, on contact with the soil, grow into regular plants and sometimes are produced bulbil upon bulbil. Indeed there seems little limit to peculiar develpments among ferns, as, for example, the many sport forms of *Nephrolepis exaltata* when cultivated.

My acquaintance with ferns began about forty-five years ago on seeing some mounted in albums and on cards. These set me to work on similar lines. My interest grew on finding there were so many different sorts. Classification was to me unknown, and literature bearing upon ferns scarce and not available. But after worrying the few botanists to be met with and working by thumb rule my knowledge increased until now my collection of dried specimens lacks only three or four species of being complete as regards the ferns and allied plants of New Zealand proper. These specimens are classified and known to me as friends by name. A gentleman once remarked of his collection of ferns, "They are the unwritten leaves of my life." Possibly many collectors will join me in repeating that sentiment. To every frond its story of adventure on hill or in valley, on precipice and level ground, in heat and cold, wet weather and dry. One might write quires and still have more to say about the beautiful ferns and how and where they grow. Are they not part of nature's lovely garments with which she clothes the otherwise naked places?

GREY LYNN, AUCKLAND, NEW ZEALAND.

Shorter Notes

A NEW MAIDENHAIR.—An odd, but beautiful, variation of the maidenhair (*Adiantum pedatum* L.) was found on Mt. Tom, Woodstock, Vermont, in August, 1928. The stipes and rachises are quite red, or reddish-brown, in color—not at all the purple-black of the common form. The pinnules for one-half to two-thirds of the length of each rachis are about normal in size, but are folded over, or twisted, in such a manner as to appear at first glance very small and to be set well away from the rachis; those of the outer portions of the rachis are somewhat larger than usual and grow flat, but so crowded as to overlap each other and entirely conceal the rachis. Six plants were found in a colony of normal plants, and they were noticeable not only for the differences in the size and shape of the pinnules, but for the marked difference in their color, which was a peculiar bluish-green, making them appear glaucous. This color, however, is not so conspicuous in the dried fronds. At first it was thought all these odd fronds were sterile, but a close examination revealed that a few pinnules on one frond bore one sorus each. The accompanying drawing is of part of the first frond collected; it was drawn full size, but in reproduction is much reduced.

As the plants were found on the Billings estate, and as Miss Billings is greatly interested in ferns, it is proposed to designate them as *Adiantum pedatum* L., forma **Billingsae,** n. f. Shaded bank, North Ridge Road, Mt. Tom, Woodstock, Vermont.—ELSIE M. KITTREDGE.

A NEW MOSS BOOK.—The appearance of the first portion of a new work on the mosses of North America, north of Mexico,[1] by Dr. A. J. Grout, will be of decided

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[1] Grout, A. J. The Moss Flora of North America, North of Mexico, Vol. 3, Part I. Pp. 1–62, pls. 1–14. September, 1928. Published by the author, New Brighton, New York City. Price, $2.50.

Adiantum pedatum, forma Billingsae

interest to many of his fellow members in the American Fern Society, whether beginners or advanced students of the group. The part now published comes as a partial fulfillment of the long-felt need of an illustrated manual which should occupy middle ground between a technical cut-and-dried treatment and a presentation of the so-called popular type, the latter, unfortunately, often lacking in continuity and failing to afford a clear, concise statement of important contrasting characters in the form of properly constructed keys. Here, however, Doctor Grout has happily combined the commendable qualities of both methods of treatment.

The present number deals with the subfamilies Climacieae, Porotricheae, and Brachythecieae of the family Hypnaceae, and contains descriptions of two new genera, *Pseudisothecium* and *Chamberlainia*. The treatment is exceptionally complete, including a discussion of the family Hypnaceae, a key to the subfamilies with descriptive notes upon them, keys to the genera, generic descriptions with pertinent critical comments, and full workable keys to the species. The specific descriptions are clear and adequate, and are followed by data as to type locality, range, and habitat, and by the citation of important illustrations and exsiccatae, along with critical comparative notes. Outstanding varieties are described also, and are discussed in more or less detail. In a word, the work is excellently conceived, and is carried out in a way that will prove exceedingly helpful to students. It is to be hoped that support will promptly be forthcoming to justify incurring the expense of continued publication.—E. C. LEONARD.

MORE FERNS OF THE VICINITY OF IRVINE, KENTUCKY.—While I was on a vacation at Irvine, Kentucky, during

the past summer, I found the following species of ferns which I had not reported in the previous article:[1]

Asplenium Ruta-muraria L. Found growing in considerable abundance on limestone cap rock cliff at the point of Henry Mountain.

Cheilanthes lanosa (Michx.) Watt. On limestone cap rock cliffs along ridge between Mt. Minerva and Chestnut Stand Church.

Polypodium polypodioides (L.) Hitchc. On limestone cliffs, Mt. Minerva.

Polypodium vulgare L. At base of oak tree near Chestnut Stand Church. This fern is quite common farther back in the mountains. At this locality the ridge has no cap rock but is sandy and covered with a forest of chestnut and various species of oak. There was only a small patch of *P. vulgare* found here. The fronds were very small, approaching *P. polypodioides* in size.—W. A. ANDERSON, JR., *University of Tennessee.*

NOTES BY THE WAY.—We enjoyed so much the letter from Mr. Pugsley to one of the editors, of which the following is a part, that we feel we should share it with our readers.

We have growing in our garden over one hundred and thirty species of wild flowers and fifty-four varieties of hardy ferns. As the wild flowers increase, I take the surplus to the woods and swamps and plant them; also seeds are saved and sown in woods and fields.

Four years ago last September, while hiking from Swastika, Ontario, to Ruyon, Quebec, a distance of seventy miles through woods and swamps, mostly the latter (Ruyon was a new mining camp, just being opened up, which I was anxious to see), being all alone on this

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[1] Anderson, W. A., and A. R. Ferns of the Vicinity of Irvine, Kentucky. AMERICAN FERN JOURNAL, Vol. 17, No. 4. 1927.

trip, which took three days to make, my time my own, I did some botanizing.

During the second day of my trip, then some thirty miles in the woods, I saw ahead of me a small pond of about two acres. Around this pond was a marsh some three or four rods wide. This entire marsh was of a sky blue color; on coming close I found it was entirely covered with *Gentiana Andrewsii*. It was the greatest sight I have ever seen. There were millions of plants.

Some days later, while on my way out from the mining camp, I found a most peculiar fern growing from under the edge of an enormous boulder. The pinnae of the fronds were growing so close that they were overlapping by one-half, thus making the frond look as if it was a double or solid affair. I took up this fern, packed the roots in damp moss, put it in my pack bag and brought it home, set it in the fern bed and awaited the developments of the next spring. When I found this fern there were no fertile fronds. It did not seem to mind its new home, for it came on and grew nicely, but produced no fertile fronds that year. But the second year it produced fertile fronds and in this it surpassed anything we have ever seen. It produced several fronds with the sori of *Asplenium* and others with the sori of *Athyrium*. Since that time it has produced sori of *Athyrium* only. It has lost all of its northern peculiarities and has become just a nice little lady fern.—F. W. PUGSLEY, *Pittsford, N. Y.*

RAISING FERNS FROM SPORES.—The following account of the experiments of one of our members in this direction will be of interest in connection with Mr. Dobbie's article on the same subject in the preceding number of the JOURNAL. It will be noted that the two methods, though unlike in detail, are similar in principle, both

aiming to give the young prothallia a continuous supply of moist air, and of water without flooding.

"Returning home we decided to break our journey at Lausanne in order to call upon a new member of our Society, M. Paul Kestner, whose home is one of the most beautifully situated places we have ever seen. He, and his English wife, received us most hospitably and we spent a few hours very pleasantly in their company. M. Kestner showed us his method of raising ferns from spores, which was on a different plan from any we had previously seen. The spores were sown on natural soil from the woods, which seemed to consist mainly of white sand with a slight admixture of vegetable mould. A thin stratum of this was placed upon strips of unglazed porcelain, something like our celluloid labels, and these were inserted into test tubes and the latter closed by well-fitting rubber stoppers. There was, thus, complete control over both the atmospheric moisture and drainage. M. Kestner said that 'every spore' germinated, but he found it necessary occasionally to take out the stoppers to introduce some carbonic acid gas, the supply of which would otherwise have been insufficient for the needs of the growing prothallia. He also found it useful occasionally to stimulate the germination of the spores by the introduction of a little ether vapor. We discussed with him our want of success in finding *Cystopteris alpina*, which he explained by saying that *alpina* is a limestone plant, whereas we had been hunting almost exclusively upon the granite and other siliceous formations."—F. W. STANSFIELD and P. GREENFIELD, *The British Fern Gazette, December, 1928.*

The following extracts from a letter from one of our more recent members will, I am sure, be of interest to many American members, both from the opportunity to

obtain spores of the considerable list of European plants and because the project to establish at Lausanne University a complete living collection of hardy American ferns is one which our members will want to assist.

CHAILLY VILLAGE
LAUSANNE
Nov. 28, 1928

Dear Mr. Benedict:

I have now obtained about everything that is hardy in the way of North American ferns, with the exception of the rarer Aspleniums and other Rock or Alpine ferns.

Most of these cannot certainly be purchased alive from anybody and the only possibility to obtain them is to raise them from spores.

I succeed fairly well with my sowings and in about three years nearly every Rock fern is adult, and I succeed to have the Alpine ferns growing happy in the Rock as in the wall.

My purpose is to complete a collection of North American hardy ferns in Europe. I see there is nowhere such one existing (I mean alive). I am doing this for the Lausanne University at the request of my friend, Prof. Wilzeak. The difficulty is to obtain the spores.

An easy way is sometimes to look for them in herbaria. A small sheet of wet paper pressed over any surface of an herbarium sheet powdered with spores will collect them, and if folded and dried and posted in an envelope, it would bring me all I require (if not too old). I would be happy to send in exchange European ferns, either alive or dried.

I enclose a list of what I can procure (next year) and a list of the ferns of which I should be happy to obtain spores. Do you think an advertisement put in the AMERICAN FERN JOURNAL would be likely to induce members to take the trouble to look for spores?

I am not quite sure about all ferns mentioned in my list being hardy, especially the Cheilanthes. On the other hand, I may have omitted some that may be hardy and which I do not yet know, especially ferns from high altitudes in the southwest.

I notice I have forgotten to send you spore leaves of *Scol. Vul.* There are no spores left on them now and the Scolopendrium I have in my garden are all plants planted this spring and there is not a leaf I should care to send as a specimen. But I enclose some spores I have collected some time ago, for sowing purposes from a wild

plant. I shall not omit to send you some next year along with *Scol. Hemionitis* of which I have young plants in my greenhouse but not yet ripe. I shall also be pleased to send you anything else that may interest you in the way of European ferns.

Yours sincerely,

(Signed) PAUL KESTNER

North American ferns, spores of which are wanted by Dr. Paul Kestner, Chailly Village, Lausanne, Switzerland.

Asplenium	*Bradleyi*
"	***ebenoides***
"	***montanum***
"	*parvulum*
"	***pinnatifidum***
Pellea	***gracilis***
"	***densa***
Cheilanthes	***vestita***
"	***lanuginosa***
"	***alabamensis***
Cryptogamme	*acrostichoides*
Woodsia	***obtusa***
"	***oregana***
"	***scopulina***

Also any other Rock ferns that may be hardy or semi-hardy.

List of ferns which can be procured next year, dried or alive, by Dr. Paul Kestner, Chailly Village, Lausanne, Switzerland.

Polystichum	*aculeatum*
"	*angulare*
Asplenium	*Adiantum-nigrum*
"	***lanceolatum***
"	***fontanum***
"	***germanicum***
"	***septentrionale***
"	***glandulosum***
"	***adulterinum***
"	*foresiacum*
Asplenium	*Hayandesii*
"	*Trichomanes* (var.)
"	*fissum*
Cystopteris	***alpina***
Grammitis	***leptophylla***
Ceterach	***officinarum***
Cheilanthes	***odora***
Notholaena	***Marantae***
"	***vellea***
Scolopendrium	*Hemionitis*

At present the Hart's Tongue spore cultures at the Brooklyn Botanic Garden have not progressed beyond the prothallium stage, so that the question of any distri-

bution of young plants must be held over, probably until the spring of 1930, though it is possible that a few young plants may be available in the early fall of this year.

On a recent visit to Syracuse, two trips were made, in company with Dr. Todd, to the Green Lake region of Jamesville. The work of the Solvay Process Company in developing its quarrying operations near East Green Lake has been resumed. A large tractor and digger is levelling off a road bed for railroad tracks within a hundred feet of the southern cliffs overlooking the eastern Green Lake; track-laying is following closely. A most distressing report was heard to the effect that it is proposed to use the lake depression as a dumping place for refuse rock. Such a development a mile away at Jamesville itself has turned a wooded hillside into an unsightly slope of broken rock, 200 or more feet high.

Rocks are being dynamited at present within 100 feet of Hart's Tongue plants.

Near the West Green Lake, several healthy colonies of Hart's Tongue were seen, one of which consisted principally of the hundreds of plants moved by Dr. Todd some two years ago. It was interesting to note the completely evergreen character of the Hart's Tongue leaves. The weight of winter snows had not broken down the resistance of the petioles. Many of the leaves still arched upward in nearly their natural position for the previous season's growth.—R. C. BENEDICT.

American Fern Society

Report of the President for 1928

The report of the Board of Editors which lies before me is an interesting and suggestive commentary on the special phases of fern study concerning which members have contributed to the pages of the JOURNAL, and it covers the ground so well that little remains to be said, other than to urge the members once more to take a somewhat keener personal interest in the success of our publication by contributing more numerous short articles and by sending in pertinent queries and suggestions bearing upon our work and presentation of results. The JOURNAL is and must be many-sided in subject-matter, to be of greatest usefulness. Its successful development and management are the subject of very sincere effort by the editors, and it is reasonable to expect a similar interest on the part of the members at large.

In one respect, it is realized, we have failed rather seriously, viz. in neglecting to build up an adequate library of semi-technical and popular fern literature for lending among the members. As a step toward remedying this, the Council has recently authorized the purchase of a complete set of the *British Fern Gazette* and has empowered the Board of Editors to expend the sum of $25.00 annually, over an indefinite period, in the purchase of suitable books. The publications thus acquired will be added to the sets of the *Fern Bulletin* and AMERICAN FERN JOURNAL now available for lending to members, and will form the nucleus of a Fern Society library. This will be deposited at the Brooklyn Botanic Garden. Through the very generous cooperation of the Garden, plans are already well advanced whereby members may borrow a wide range of fern volumes from that institution. Details of the arrangement will be published shortly in the JOURNAL.

With respect to the Fern Society's library it is suggested that members help along the project by sending in reprints of any articles upon ferns, duplicate fern magazines, and books, since with the slender cash resources at hand its development may otherwise be slow. It will be helpful in the long run also if members will make the Society the legatee of their fern libraries, as well as their herbaria.

Respectfully,

WILLIAM R. MAXON, *President.*

Report of the Treasurer for 1928

GENERAL FUND

Received

Cash on hand Jan. 1		$ 850.38
Membership dues, 1926	$ 3.00	
1927	42.00	
1928	390.05	
1929	30.00	
1930	3.25	
	$468.30	
Subscriptions to JOURNAL	77.64	
Illustrating Fund—Gifts	16.64	
Emergency Fund (sale of Back Numbers)	107.83	
Advertising	4.00	
Special for Dr. Waters' Key	20.00	
Miscellaneous	.70	
	695.11	
TOTAL RECEIVED		$1,545.49

Paid Out

JOURNAL expenses:		
Printing 4 Numbers	$257.00	
100 extra copies each No.	24.00	
Title page, contents, index	10.00	
8- and 6-point composition	2.18	
Carried forward	$293.18	$1,545.49

Brought forward		$293.18	$1,545.49
Editor's postage		1.25	
Brooklyn Botanic Garden postage		7.18	
Illustrations Budget	$30.00		
Illustrating Fund	36.28		
		66.28	
Waters' Key and extra pages Budget	45.00		
Gift, Dr. Waters	20.00		
		65.00	
Printers' charges, mailing	18.40		
Stencils	1.88		
		20.28	
Total cost of JOURNAL			$453.17
Treasurer's expenses			39.26
Secretary's expenses			19.50
On 1927 acct. express on JOURNALS to Brooklyn, N. Y.			22.32
Loss on check credited but not collected			7.50
Exchange			.89
Subscription refunded			1.12
Total Paid Out			543.76
BALANCE ON HAND			$1,001.73

This Balance is made up as follows:

EMERGENCY FUND:		
On Hand, Jan. 1	$114.61	
Rec'd, sale back numbers	107.83	
Bal. on Hand		$222.44
ILLUSTRATING FUND:		
On Hand, Jan. 1	$ 45.84	
Received, Gifts	16.64	
	$ 62.48	
Used on JOURNAL	36.28	
Bal. on Hand		26.20

Special Order holding for catalog of the herbarium	25.00	
General Fund unappropriated	728.09	
		$1,001.73

SPECIAL RESERVE FUND

On Hand, Jan. 1	$796.45
Life Memberships received	50.00
Interest received	41.65
BALANCE ON HAND	$888.10

Respectfully submitted,

JAY G. UNDERWOOD, *Treasurer.*

Report of the Editors for 1928

A survey of the pages of the JOURNAL for 1928 prompted a review of some of the earlier numbers and this in turn has suggested a number of reflections. The JOURNAL is eighteen and a half years old, with a history of eighteen volumes (the first had six numbers), comprising some twenty-four hundred pages. The last four issues, with Dr. Waters' supplement, contain some one hundred and fifty pages; the first two numbers had sixteen each.

Throughout the years there has been clear evidence of a community of interests among fern lovers, resulting in a most delightful interchange of ideas and experiences. We cannot all "gypsy" across the islands and continent of North America like the Ransiers, or explore the shores of New Zealand with Mr. Dobbie, or the jungles of Panama with Mr. Killip; and yet we have been doing these very things through the pages of the JOURNAL. And we have all had our own unique experiences which we can share with others by writing about them.

There lie in the field of fern study many important facts yet undiscovered. This work of discovery may con-

sist of pioneering and extensive studies like those of Dr. Maxon, or exhaustive, monographic discrimination within one genus, like that of Prof. Schaffner. On the other hand, there are innumerable facts awaiting the investigator in connection with the commonest species.

One of the most interesting and valuable contributions which the FERN JOURNAL can make is to receive and record the observations of a large number of careful field students on some particular fern problem. The symposium on the habitat of *Ophioglossum vulgatum* published some years ago, and the more recent discussion of the status of *Botrychium dissectum-obliquum* are illustrations of this point. The last number for 1928 contained a question, the answers to which must come principally from European members and friends: that regarding the ecological distribution of *Dryopteris dilatata*, but there are plenty of other questions which need for their answer careful observation within the United States and Canada. The editors will appreciate suggestions regarding such comprehensive questions which you would like discussed.

The conservation of native species has long been a matter of interest to FERN JOURNAL readers. As early as the second volume, in 1912, we find the title, "A plea for fern protection" by Orra Parker Phelps, an article relating to the collection for florists of the common shield ferns. It is a matter of record that a fern species had priority in the way of legal protection, the climbing fern having been so distinguished in Connecticut as far back as 1867. The most rapid and extensive progress has been made within the past ten years, but there remain many states which have not yet begun to give legal protection, and the problem of artificially reproducing and restocking has only been started in a most limited way. Here

is a field for the most valuable kind of effort by fern lovers, and the JOURNAL is open for the recording of programs and results.

Fern growing in out-door gardens is probably the starting-point of interest in ferns for a considerable number of our members. Fern growing indoors has been decidedly limited with us to the temporary maintenance of some gradually declining greenhouse plant, usually a Boston fern, but this is a field deserving much more attention than it has received. There are from twenty-five to fifty species which can be accommodated successfully in most homes, without recourse to over-exacting cultural requirements. We may hope that our increasing number of British members will feel moved to give us the benefit of their greater experience in fern growing.

We are glad again to recommend to our members who may have special interest in this line that they write to Dr. F. W. Stansfield for a sample copy of the *British Fern Gazette*. It would be a most happy development if our respective societies should come to have to a large extent an interlocking membership.

Finally, it may be noted that although the "standard" size of the FERN JOURNAL has long been thirty-two pages, this is not a fixed restriction. We venture a prediction that before volume twenty is finished, the minimum will have risen to forty pages with the editors asking for budget allowances for extra pages as at present.

R. C. BENEDICT,
E. J. WINSLOW,
C. A. WEATHERBY,
Editors.

Report of the Judge of Elections

At Dr. Maxon's request I have acted as judge of elections this year for the American Fern Society and beg to report the following results of the election of officers for the Society:

The total number of ballots received is 85, and each of the four persons in nomination received 85 votes, viz.:

For *President:* William R. Maxon.
For *Vice-President:* Carlotta C. Hall.
For *Secretary:* Charles S. Lewis.
For *Treasurer:* J. G. Underwood.

Sincerely yours,
(Signed) H. D. HOUSE, *State Botanist.*

State Museum, Albany, N. Y.,
January 22, 1929.

Mrs. Ella Louise Horr, a member of the American Fern Society since 1911, died on the 24th of October, 1928, in Worcester, Mass., where she had lived the greater part of her life.

Mrs. Horr was born on Jan. 1, 1854, a daughter of Mr. and Mrs. Charles Brown. She graduated from the Worcester State Normal School in the class of 1891, and taught for eleven years in the schools of that city. In 1903 she was married to Richard R. Horr, of Sudbury. Her husband died ten months later.

In 1905 she was appointed custodian of the Natural History Museum in Worcester and held that position until she was compelled to give up the work on account of illness in 1923. She had a wide interest in all forms of nature study and a thorough knowledge of the local botany and ornithology. Under her direction the collections at the museum were greatly enlarged and efficiently organized. She was especially skillful in conducting

children's classes, and the impulse given to nature study by her administration at the museum will be felt for generations to come.

Dr. Dana W. Fellows, formerly of Portland, Me., and a member of the American Fern Society since 1900, died on the 23d of December, 1928, at his home in Port Richmond, Staten Island, N. Y.

Dr. Fellows was born in Lincoln, Me., eighty-one years ago. He graduated from Mattanawcook Academy and from Bowdoin Medical School in 1877. He practiced dentistry in Portland and was an active member and official of the dental and medical associations of the city, county and state for many years.

He was an enthusiastic amateur botanist with a special interest in ferns and for many years president of the Josselyn Botanical Society of Maine. His first wife, Mary Louise Niles, of Fort Kent, died in 1916 and six years later he was married to Cora L. Butler, of New York City, who survives him.

Anna D. (Mrs. J. H.) Parker, a member of the Society since 1923, died during a visit in Brookline, Mass., Feb. 19, 1929, aged about seventy. She was a native of Scotland, but her home for many years had been in Cliftondale, Mass. For some thirty years she had been a summer resident of Monterey, in the Berkshire Hills, where the family occupied a pleasant old farm house in the midst of a large tract of field and woodland sloping down to a lake. Recently they had made their home there all the year round.

Those of us who attended the meeting of the Society at Monterey, which Mrs. Parker made possible, will recall her kindness and hospitality, her eager enthusiasm for ferns, and her interest in the doings of the Society—

an interest evinced by regular attendance at other field meetings, often at a distance and sometimes in spite of considerable physical disability. In her the Society has lost a valued member.

PROPOSED FIELD TRIP, SEPTEMBER 1–2, 1929.—A committee appointed by President Maxon is planning a trip for Labor Day this year to Harper's Ferry, West Virginia, where the smaller Aspleniums, also two species of Cheilanthes, and many other ferns can be seen in considerable abundance without excessive hiking or climbing. Harper's Ferry is situated about 60 miles northwest of Washington, D. C., and can be reached in one and a half hours by the B. & O. Railroad, or in two hours, over good roads, by auto. It is proposed to assemble Saturday evening at a hotel, to be designated later, spend Sunday on a trip several miles up the Shenandoah River, Monday morning in shorter trips around the town, and return home Monday afternoon. Details will be announced early in August.

MARY F. WRIGHT, MAURICE BROOKS, EDGAR T. WHERRY,
Committee.

HOW MANY WOULD LIKE BOUND COPIES OF DR. WATERS'S "FERN KEY"?—Mr. Charles C. Deam writes to ask about the possibility of having copies of Dr. Waters's "Analytical Key for the Ferns of the Northeastern States based on Stipes," bound in some flexible cover for convenience in field work. Inquiries concerning the cost of such binding are being made. Any members who would be interested in ordering such bound copies are asked to write an inquiry to me at the Brooklyn Botanic Garden. When I have the information as to cost, etc., available, I will send it to those who have written.—RALPH C. BENEDICT.

THE NEW YORK MEETING OF THE SOCIETY.—In combining social and educational features, the American Fern Society was probably the most successful of all those meeting with the American Association for the Advancement of Science, Christmas week, 1928. This, of course, was due to the Program Committee, Rev. Charles S. Lewis, Dr. Marshall A. Howe, Frederic W. Kobbé, and, last but not least, Dr. Ralph C. Benedict.

The first session was called to order by Dr. Benedict at 2 o'clock on Saturday, December 29th, in Macy Hall, Teachers' College, Columbia University. Thirty-four persons signed the register that day. We heard a talk by Prof. John H. Schaffner on "The Diagnostic Characters of Equisetum." This sounds more formidable than it really was, and in the future all of us will look with more interest and intelligence at the lowly horsetail tribe. Prof. Schaffner's specimens were works of art, beautifully mounted and secure against any harm from handling. Dr. E. T. Wherry's subject was "Soil Reaction Preferences of Native Ferns," illustrated by colored slides so perfect that involuntary oh's and ah's greeted each one. Prof. Fr. Marie-Victorin, of Montreal, showed us specimens and photographs of a Botrychium he found on an island in the Gulf of St. Lawrence. He gave his reasons for thinking that the fern should be given specific rank. Mr. C. A. Weatherby told us a little about "Recent Systematic Work on Northeastern Ferns."

At this point in the program Dr. Benedict took the floor and invited every one to follow him to a Japanese restaurant for dinner. About a dozen of us accepted his invitation and soon were mightily pleased with ourselves for having done so. What we ate was a mystery, but that only added to the gayety of the occasion. For my part, I was torn between the desire to devour my intrigu-

ing dinner and the desire to ask Dr. Wherry, Dr. Benedict, and Mr. Weatherby all the questions possible in a limited time.

The next day the scene shifted to Brooklyn and the Botanic Garden, where Dr. Benedict acted as host, guide, and teacher. We saw hundreds of varietal forms of the Boston fern, from the original *Nephrolepis exaltata* var. *Bostoniensis* to mere balls of finely-divided leaves, too soft to be of commercial value, but interesting to the botanist. Dr. Benedict went into details on the development of this popular house fern besides answering innumerable questions hurled at him from all sides. In another house we saw rare ferns such as *Angiopteris erecta*, a primitive species native to Asia and Africa, and *Todea barbara*, the only one of its kind in the United States. To most of us *Salvinia* and *Azolla* were rare, so that we availed ourselves of the opportunity when our generous host told us to help ourselves.

Although darkness was almost upon us, we walked back past the lotus pond and the famous Japanese garden to the equally famous rose garden and so to the subway station where the 1928 meeting was officially ended.
—RACHEL L. LOWE.

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Vol. 19 July-September, 1929 No. 3

American Fern Journal

A QUARTERLY DEVOTED TO FERNS

Published by the

AMERICAN FERN SOCIETY

EDITORS

R. C. BENEDICT

E. J. WINSLOW C. A. WEATHERBY

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The American Fern Society

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American Fern Journal

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RALPH C. BENEDICT ..... 1819 Dorchester Road, Brooklyn, N. Y.
E. J. WINSLOW ..... Auburndale, Mass.
C. A. WEATHERBY ..... Cambridge, Mass.

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The Flowers of Equisetum.[1]

John H. Schaffner

Among the homosporous pteridophytes, the typical ferns as well as the lowest clubmosses have only indeterminate buds, the zones of sporophylls alternating successively with the zones of foliage leaves during the ontogenetic development. The species of *Equisetum*, however, have three types of axes—indeterminate underground rhizomes, aerial determinate vegetative shoots, and aerial determinate reproductive shoots which end in cones. These cones are typical primitive flowers. A flower is a determinate, sporophyll-bearing shoot or a modification of such a shoot. The three characteristics of a flower are: first, the complete stopping of growth and final death of the floral bud and axis; second, the crowding of the sporophylls, probably because of the activity of the factors of determination; and third, the differentiation of the sporophylls from the foliage leaves. All the highest flowers have these three characteristics and since the flowers of *Equisetum* have the same they are true flowers, scientifically speaking.

The most striking thing, perhaps, to be observed about *Equisetum* flowers is the fact that there is a com-

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[1] Papers from the Department of Botany, the Ohio State University, No. 228.

[Volume 19, No. 2, of the Journal, pages 37–76, figs. 3 and 4, was issued May 21, 1929.]

plete gradation of semi-sterile and sterile shoots between the normal cone and the vegetative shoot. In the higher plants one expects to find a branch ending either in a normal flower or in a leafy bud. But since *Equisetum*, although highly specialized in some respects, is a very primitive type of vascular plant, the hereditary expression brings out cones of every size and degree of perfection from the vegetative condition to the normal cone of the species. The sporangia borne on the sporophylls of the imperfect cones are also of all grades of perfection and this fact no doubt explains why Hawkins[2] found "two types of sporangia differing in development and governed by the direction of the second division." It would be interesting for someone to make a complete study of the different types of cones in a number of species showing the gradation series prominently, like *E. praealtum* and *E. palustre*. The species Hawkins studied was *E. praealtum*.

In general, the lower the species in the general evolutionary scale the more abundant are the intermediate cones. In *E. arvense* they are quite rare and when they appear on the green, vegetative shoot the plant has heretofore been called *E. arvense campestre*. The normal flowers also fluctuate very greatly. The mechanism of determination does not work promptly nor definitely, so both the number of whorls and the number of sporophylls in a whorl vary greatly. In some species also proliferation is common as in *E. fluviatile*. Such proliferation is also characteristic of low types of flowers in other groups, like species of *Lycopodium*, *Araucaria*, and *Rosa*. In such cases the factors of determination are so unreliable in their action that they fail to work at all for

[2] HAWKINS, LON A. The Development of the Sporangium of *Equisetum hyemale*. Ohio Nat. 7: 122–129. 1907.

the time being and the bud falls back to the vegetative condition again. In the more specialized types of flowers, proliferations are exceedingly rare or do not occur at all. Some horsetails have added specializations to their floral heredity which also interfere with proliferation to a great extent. Of this nature, apparently is the hard, spine-like point of *E. praealtum*.

The flowers of the various species of *Equisetum* show a remarkable, progressive evolution, which parallels in a general way the progressions made in a more decided manner in the higher, flowering plants. The lower types, like *E. giganteum* and *E. laevigatum*, are green until maturity, losing their chlorophyll only at the time the spores are being shed. The intermediate types change from green to yellowish at an early stage, while the highest normally never have any chlorophyll at all. The orthogenetic nature of this movement is strikingly indicated when comparing *E. fluviatile* and *E. palustre* with *E. silvaticum* and *E. pratense*, and the latter two species with *E. telmateia* and *E. arvense*. Such a general movement in the loss of chlorophyll in the reproductive branch is duplicated a great number of times in the higher plants. The lower species of *Equisetum* develop flowers only on old aerial stems, the intermediate species develop them early in the development of the aerial shoots of the season while the highest, like *E. arvense*, develop the flower shoot entirely underground, which then expands very rapidly in the spring and dies immediately after the spores are shed.

Although the evolution of determinateness of the flower does not go very far in *Equisetum*, nevertheless the lowest species have cones with prominent points, and a gradual vegetative decline of the terminal bud follows the production of normal sporophylls. In the highest

species the terminal bud develops sporophylls to the end and then stops growth promptly; hence the cones are not at all apiculate. This condition is seen in all the higher species as well as in such intermediate forms as *E. kansanum*, in which there is usually only a slight development of the point or none at all. This fact along with other developments places *E. kansanum* above *E. laevigatum* and *E. praealtum* in the evolutionary series. As would be expected, since *E. kansanum* has just emerged from the more primitive condition, speaking from the evolutionary point of view, there is considerable fluctuation in the tip of the cone.

The lower species show only a slight development of the peduncle, the cone resting in the uppermost leaf sheath. In *E. silvaticum* the peduncle is rarely over 2 in. long and usually less and the same is true of *E. pratense*, while in *E. arvense* it may reach a length of 5 in. In all species the peduncle shows great fluctuation. Thus in *E. arvense* it may not be over ½ in. long. The lowest species fluctuate within the narrowest limits.

The so-called "ring" or calyx is a very interesting structure representing the whorl developed on the transition zone from the beginning of latency of certain vegetative factors to the awakening to activity of the reproductive factors of the sporophyte. Thus a structure is produced which is neither leaf sheath proper nor sporophyll whorl proper. The separate sporophylls represent a more primitive condition of distinct leaves and the lack of internodal development in the cone also represents a condition which must have been characteristic of *Equisetum* ancestors before the internodal factors were evolved. When these factors were added they were of such a nature that they become inactive in the presence of the functional conditions of the final determinate

gradient, which is played out in the development of the cone. Here as in very numerous cases in the higher plants the ontogeny repeats the phylogeny at the end of the life history of the shoot rather than at the beginning. The united sheaths also represent a new heredity evolved on top of the old one. This new heredity also expresses itself only in the vegetative gradient. The peltate sporophylls are assumed to represent highly modified leaves. There is no need of indulging in any other fantastic speculation. The tooth appendage still present on the leaf sheath is entirely obliterated. The changes brought about in the phylogeny simply represent new heredities added to the cell from time to time which modify the action of the heredities, present before, at certain stages of the ontogenetic cycle. The past morphology has looked too much on the plant as put together of parts as a house is built of bricks, stones, and boards. But a more correct way of looking at the matter is in thinking of hereditary potentialities added from time to time which modified or changed entirely the action of the heredity originally present which was responsible for the "bricks," "stones," and "boards." In this way a new kind of leaf sheath is evolved and in the most primitive species the calyx has sporangia on the upper side,[3] because the progress of the functional gradient brings the reproductive factors into play when this point is reached. As the evolution proceeds the activities and latencies on the transition zone become more definite until along with the development of a peduncle a sterile calyx is evolved. Such a general movement can also be traced in the higher *Selaginella* species, in various *Gymnospermae*, and, of course, comes at its highest

[3] See BROWNE, ISABEL M. P. A New Theory of the Morphology of the Calamarian Cone. Ann. of Bot. **41**: 301–320. 1927.

development in the *Anthophyta*. In the *Equisetum* flower the calyx is only moderately modified from the texture of the sporophylls because of the simplicity of the hereditary constitution. There is simply a combination of sporophyll and leaf sheath characters with no special heredity present to modify the expression into peculiar forms, colors, textures or patterns, as is so strikingly the case in many of the higher flowers.

(*To be continued*)

COLUMBUS, OHIO

Ferns and their Allies in Washington County, Maine

CLARENCE HINCKLEY KNOWLTON

For some twenty years I have usually spent part or all of my summer vacation in Machias, Maine, and the adjoining town of Roque Bluffs, about midway between Mt. Desert and Eastport. In this way I have come to know the flora of this immediate region very well indeed, and the last few years I have been making definite efforts to know the flora of the entire county. Finding that my knowledge of the local ferns and their allies was rather limited I have taken special pains the past two years to add stations, and to study the distribution of these plants.

Washington county is the easternmost coastal county of Maine, including the most eastern land within the United States. It stretches inland to Aroostook county and includes 2,456 square miles of territory. The coastal towns have long been settled, and the people are busily engaged in fishing, lumbering and trade, with a moderate amount of general farming. Back from the coast is a series of towns with many abandoned farms, largely

given over to the blueberry industry. Back of these is continuous evergreen forest of the Canadian type, with occasional patches of upland where there are deciduous trees, "hardwood growth" of beech, yellow birch and sugar maple.

For comparison with other areas it has seemed to me that it would be of some value to publish a fern flora of this county. I do not regard my own explorations as final and complete, but they seem to have reached a point where it is worth while to record them. I have included the findings of several other collectors. Dr. G. G. Kennedy spent three full days at Cutler on the coast in 1901 (reported in *Rhodora* iv. 23, 1902). He was so much interested that the following year he returned with Mr. E. F. Williams, Professors M. L. Fernald and J. F. Collins for a more extensive visit. The same year the Josselyn Botanical Society of Maine held its summer meeting in Machias, and Miss Kate Furbish became interested in the region, particularly in Cutler and vicinity. In 1907 Messrs. J. A. Cushman and S. N. F. Sanford collected on the islands and forelands for the Boston Society of Natural History. In 1909 Professors M. L. Fernald and K. M. Wiegand explored the towns from Dennysville and Pembrok e east. In 1912 and 1913 Mr. S. N. F. Sanford located several interesting species and varieties in the extreme eastern towns of Washington county. The specimens on which the following list is based are included in my own collection and in those of the New England Botanical Club, the Gray Herbarium and the Boston Society of Natural History.

POLYPODIACEAE

Polypodium virginianum L. Ledges, occasional.

Thelypteris Dryopteris (L.) Slosson. Rich woods, common throughout.

T. Phegopteris (L.) Slosson. Rich moist woods, common.

T. palustris Schott. Swamps and wet fields, frequent.

T. noveboracensis (L.) Nieuwl. Shady places in woods, common.

T. marginalis (L.) Nieuwl. Rocky woods, Pembroke, Eastport, Princeton, Cooper.

T. Boottii (Tuckerm.) Nieuwl. Swamps, Roque Bluffs, Machias, Whitneyville, Wesley.

T. cristata (L.) Nieuwl. Swamps, common.

T. spinulosa (O. F. Mueller) Nieuwl. Moist soil in woods, common.

var. *intermedia* (Muhl.) Weatherby. Rich woods, especially deciduous woods, common.

var. *americana* (Fischer) Weatherby. Rich spruce woods near the coast. This is the handsomest of the ferns in the county. It grows in great masses in moist places, the big fronds 90 to 125 cm. in length, and 3–4 dm. wide. Along with it is an abundance of *Solidago macrophylla* Pursh, which also flourishes with it in the mountain woods of western Maine, New Hampshire and Vermont. Here the two species often grow close to tidewater, and must sometimes be sprayed by the salt water at high tide.

Pteridium latiusculum (Desv.) Hieron. Dry fields, pastures, roadsides and open woods, very common and abundant, especially back from the coast.

Athyrium acrostichoides (Michx.) Desv. Rich woods at Big Hill, Pembroke (Fernald); rich deciduous woods, East Ridge, Cooper.

A. angustum (Willd.) Presl. Dry fields and roadsides; common, especially back from the coast.

var. *rubellum* (Gilbert) Waters. Frequent in moist woods inland.

var. *elatius* (Link) Butters. Woods, Roque Bluffs.

var. *laurentianum* Butters. Moist woods, Princeton (Sanford).

Polystichum acrostichoides (Michx.) Schott. Occasional inland, especially in deciduous woods.

Cystopteris fragilis (L.) Bernh. Moist crevices in ledges; Jonesboro, Perry, Lubec.

Woodsia ilvensis (L.) R. Br. Dry ledges; Perry, Eastport, Jonesboro.

Dennstaedtia punctilobula (Michx.) Moore. Pastures and open woods, very common.

Onoclea sensibilis L. Wet woods and swamps, frequent inland.

Pteretis nodulosa (Michx.) Nieuwl. Alluvial woods at base of Big Hill, Pembroke (Fernald); swampy woods. No. 31; moist soil near lake, Meddybemps.

OSMUNDACEAE

Osmunda cinnamomea L. Moist soil, meadows, swamps and bogs, very common.

O. Claytoniana L. Moist soil, roadsides and pastures, very common.

O. regalis L., var. *spectabilis* (Willd.) Gray. Moist bank, Moose Island (Fernald); Marion; occasional inland, especially along the rivers.

OPHIOGLOSSACEAE

Ophioglossum vulgatum L. Moist soil, Perry.

Botrychium simplex E. Hitchcock. Knolls in rich hillside thickets, Cutler (G. G. Kennedy *et al.*, 1902): pasture, Machias (Kate Furbish *et al.*, 1902). The latter station was well known for several years, but the pasture has been burned over since 1902, and I have never been able to find the plant myself.

B. matricariaefolium Braun. (*B. ramosum* (Roth) Aschers.) Deciduous woods, Big Hill, Pembroke

(Fernald); dry open woods, Cutler (G. G. Kennedy *et al.*).

B. ternatum (Thunb.) Sw., var. *intermedium* D. C. Eaton. Moist field, Indiantown; Pembroke (Fernald); Cutler (Kate Furbish). This and its related forms are rare in Washington county. The probable reason for this is the custom of burning the open country every third year to keep the soil fit for blueberry culture. Relatively few herbaceous plants are able to survive this treatment.

B. virginianum (L.) Sw. Rocky woods, Big Hill, Pembroke (Fernald); rich deciduous woods, East Ridge, Cooper.

var. *laurentianum* Butters. Rich upland meadow, Cutler (G. G. Kennedy *et al.*).

EQUISETACEAE

Equisetum arvense L. Very common throughout.

var. *decumbens* Meyer. Pembroke and Cutler, in gravel, doubtless frequent elsewhere.

E. limosum L. Swamps and wet river shores; Cherryfield, Machias, Whiting, Calais.

E. hyemale L., var. *affine* (Engelm.) A. A. Eaton. Gravelly bank, Ayer's Junction, Pembroke (Fernald).

E. sylvaticum L., var. *pauciramosum* Milde. Roque Bluffs, perhaps elsewhere.

f. *multiramosum* Fernald. Moist open woods, common.

LYCOPODIACEAE

Lycopodium inundatum L. Mossy barrens, Moose Island (Fernald); moist sandy soil, Marshfield.

L. annotinum L. Open woods, Roque Bluffs; low woods, Perry (Sanford).

var. *acrifolium* Fernald. North Lubec (Sanford).

var. *pungens* Desv. Heathy pasture, Roque Bluffs; dryish heath, Boot Cove, Lubec (Fernald); mossy spruce woods, Cutler (G. G. Kennedy *et al.*).

L. clavatum L. Pastures, roadsides and dry open woods, common.

var. *megastachyon* Fernald & Bissell. Frequent in similar places.

var. *subremotum* Victorin. Roadside, Machias. In this interesting variety there are three to five spikes, well pedicelled, the lower two to six centimeters below the upper.

L. obscurum L. Dry woods, frequent.

var. *dendroideum* (Michx.) D. C. Eaton. Cherryfield, Machias, Roque Bluffs.

L. flabelliforme (Fernald) Blanchard. Dry open woods, common.

L. tristachyum Pursh. Sand-plain, Columbia; dry rocky woods, Big Hill, Pembroke (Fernald).

SELAGINELLACEAE

Selaginella rupestris (L.) Spring. Dry ledges: East Machias, Pembroke (Fernald).

ISOETACEAE

Isoetes echinospora Dur., var. *Braunii* (Dur.) Engelm. Sandy bottoms of shallow ponds and lakes, also quiet stretches of the rivers, common.

HINGHAM, MASSACHUSETTS

Woodwardia areolata, the Traveling Fern

FRANK W. PUGSLEY

Eight years ago last August, while hiking on Staten Island near Tottenville, along the Arthur Kill Road, which was an ordinary dirt road and very much neglected, I came to a piece of oak woods, and a place where a wood or log-road turned off through the woods: this I followed for some distance, when to my surprise and delight right near this wood-trail I saw a stand of several hundred plants of *Woodwardia areolata* growing in a wet sandy piece of ground. I took up several roots, packed them in damp moss, and a few days later brought them to our garden in Pittsford, about four miles from Rochester, N. Y., where they were planted in the fern beds along with many other species of ferns and shade-loving native plants. We were told that the *Woodwardia areolata* would not live in our part of the country, nevertheless I decided to give them a try-out. Knowing that the soil in the Staten Island wood must be strongly acid, due to the great quantities of oak leaves decaying, our plants have therefore been given a tannic acid solution about once every four weeks during the summer months. With this treatment they have thrived beautifully.

Two years ago last August, while in Perth Amboy, N. J., I decided to visit my fern bed on Staten Island, so took the ferry to Tottenville. What was my surprise on reaching the Arthur Kill Road at the outer edge of Tottenville to find that a wonderful change had been wrought: here, instead of a neglected dirt road, was a concrete highway, with subdivisions, and building going on. I hurried along, wondering if someone had built a house on my fern bed. On reaching the entrance to the wood trail there was a big sign reading "Lots For

Sale'': hurrying up the trail I beheld my fern bed still intact so far as building operations were concerned, although the woods had been cleared nearly to this point. The sand had washed down from the wood road and covered about half of the fern bed.

I sat down on a log and marveled as to how long it would be before man destroyed the rest of these wonderful ferns: something must be done to save them, so with trowel and fingers I took up nearly all that were left, over one hundred; packed them in wet moss and rolled them in many thicknesses of paper, brought them home and planted them in several large swamps near by, where conditions are very much the same as they were in the Staten Island wood. They are doing nicely, thriving as if they had always been in their present location.

I believe in saving the more or less rare plants, even if they have to be moved several hundred miles, and by so doing mix up the botanists a little.

The different authorities on ferns state that *Woodwardia areolata* has a creeping rootstock. I find on examining the rootstocks of a large number of these ferns that they are not only creepers, but systematic travelers: they proved to have traveled approximately twenty-four inches in six years. The rootstocks contained portions of each year's growth of fronds for a period of five and six years: from this I was able to deduce their rate of growth, or travel, and found they were all very much the same in this. Taking one fair sample, will give its rate of travel for six years: first year, it traveled five inches: second year, three inches; third year, five and one-half inches; fourth year, two and three-fourths inches; fifth year, three and three-fourths inches; and the sixth year, four inches.

The rate of growth each year would indicate that the weather conditions had much to do with it; namely heat

"The Traveling Fern," Woodwardia areolata

and moisture. The main rootstock has only a few hairy rootlets growing out at or near the points where each year's growth of fronds is shown; the rootstock averages about one-eighth of an inch in diameter, is nearly black and somewhat scaly.

On examining a large number of these ferns it appears that the rootstock branches into two stocks every six years, with few exceptions, where it was shown to have branched at the seven-year period. Each stock, then, traveling for six years, covers approximately twenty-four inches, and then branches, doing the same thing over and over again for many years. This accounts for a large bed of these ferns being almost entirely grown together.

The writer is convinced that the *Woodwardia areolata* is not a blind creeper, but a systematic traveler.

PITTSFORD, N. Y.

Cultivation of Ferns under Lath in Southern California

EDWIN WESTLEY

It is with some reluctance that I comply with the request to write an article on "Cultivation of Ferns Under Lath," realizing, as I do, that I am but a novice although ferns have long been a hobby of mine. To me there is nothing more interesting than to see the fronds of some especially prized fern uncoil, for nature has bestowed a truly wondrous beauty in the symmetrical outline of each dainty frond.

Perhaps the members would like to know how I first became interested in ferns? I have always enjoyed raising plants that seemed to most people difficult to grow, and been delighted when I would succeed and be able to

show my friends the results of my efforts. As most people contend that ferns are difficult to grow, it was only natural that I should attempt to raise them successfully under adverse conditions. At Christmas time of the year 1918 I bought a holiday floral basket for a friend of mine. Among the flowers was a fine *Pteris Wimsetti* fern, and my friend suggested that I had better take the fern to raise as she had no place to keep it and give it proper care, and she did not like the thought of seeing the beautiful plant wither and die. So I took the fern and planted it out of doors, first in one spot and then in another until I finally found the ideal location for it. I have since learned that they require a sandy soil with plenty of leaf mold and, generally, a rather acid soil kept quite moist. That was really the beginning of my interest in ferns but it was not until about three years later when, while on a trip to Ventura, I stopped to see Mrs. Sheppard, the Petunia fancier, whose mother was a fern enthusiast and collector, that I learned that there were so many species; and I marveled at the beauty of her collection. As I had been successful with the *Pteris Wimsetti*, which I still have, I determined to have a fernery. The ferns which I bought had mostly been raised under lath, so I replanted them under lath. As my collection has grown larger I have had to continually extend the lath house. My present fernery measures 30 x 40 feet and is 13 feet in height. It contains between two and three hundred varieties and, besides, there are innumerable sporelings of *Pteris longifolia*, *Pteris tremula*, *Dryopteris patens*, *Nephrodium molle*, *Woodwardia Chamissoi* and many others.

In September of 1921 I, together with a group of friends, chartered a fishing launch and went on a vacation trip to Santa Cruz Island where I obtained my first

specimen of *Woodwardia Chamissoi*. My friends were sure that the plants would not live until I got home again and told me I was foolish to bother with them. I carried them to Catalina Island and from there to the mainland on a passenger steamer and then on the interurban to Pasadena and I was proud indeed that I did not lose one of the seven specimens I brought with me.

Ferns, it seems to me, grow in many different kinds of soil. That is, the various species require the kind of soil that is particularly adapted to the needs of each individual species. I have found it necessary to go great distances into mountain and valley after soil for my fernery, and by changing the ferns around into the various soils I finally find the right soil condition for each species. My Platyceriums (*P. alcicorne*, *P. Hillii*, and *P. grande*) are all in hardwood logs, hollowed out and filled with leaf mold, rich loam and Oregon green moss. They have thrived out of doors all these winters but are rather slow of growth. They have been in the pink of condition until this year when they were frosted during the rather severe cold spell which came unexpectedly after a very mild early winter. I have quite a number of eastern ferns in my collection and they are also doing nicely. My *Osmunda regalis*, which in this locality never attains any great size, is now three feet high and other fronds, I believe, will go far beyond that.

I have quite a number of ferns in my fernery of which I do not know the names. I have six fine sturdy specimens of *Pteris argyrea;* a fern which even professional fern growers claim to be hard to raise. I have now had them over two years and they are thirty-one inches high. The *Scolopendrium*, or Hart's Tongue, is producing fronds in wild profusion. It is curious to note the many forms

the Hart's Tongue achieves under careful cultivation; of the five specimens I have, no two seem to be exactly alike. Thus far, the *Pteris adiantoides* is my favorite. Mine spreads its fronds in beautiful fan shapes, while those I have seen in hothouses—where they are usually raised—seemed to be more of a prostrate vine-like fern. I have several specimens of the beautiful *Davallia* group of ferns, also the *Cibotium Barometz* and the *Cibotium Schiedii.* The *Cibotium Schiedii* is another delicate greenhouse fern, but the two that I have have wintered out of doors and are putting forth large fronds, larger than any I have ever seen in this locality before.

The raising of ferns is not an easy task for the average amateur, but persistence and experimentation with the various soils will speedily result in a fernery one can be proud of and which will be the envy of one's less fortunate friends.

I find that a pool in the fernery is a very desirable feature as it not only adds to the attractiveness of the fernery but provides a habitat for the frogs who are so useful in keeping down slugs, snails and injurious insects. Some writers contend that frogs destroy the fish spawn in small pools. Slugs and snails are very destructive to ferns and must by all means be eliminated from the fernery by the use of frogs or chemicals. I find that spraying with Black Leaf 40 is quite beneficial to the ferns in eliminating hard and soft scale, aphis, rust, thrip and fungi.

Now that we are unfortunately unable to secure fern specimens from abroad owing to the embargo on importation, is there not some means by which American fern enthusiasts might secure the names of firms or individuals in foreign lands from whom they could secure fern spores by purchase or exchange? I personally have

had great difficulty in getting in touch with foreign fern establishments. While I personally have not as yet attempted to raise ferns from spores, I have some friends who are familiar with fern spore culture and have the proper facilities for raising them; one in particular having been formerly associated with Kew Gardens, London. May we not have the thoughts of other members on this subject?

I should like to take this opportunity to acknowledge my great indebtedness to several members of the American Fern Society in foreign lands, particularly Mr. H. B. Dobbie of New Zealand, Dr. Leroy Topping of Hawaii, and also a personal friend of Dr. Benedict, Prof. Johnson, during a vacation spent at Barro Colorado Island, Panama. It may interest our friends to learn that the spores sent me from New Zealand have germinated and are now ready for the thimble pots, and those from Hawaii are showing very encouraging signs of germination.

PASADENA, CAL.

Collecting in the Mountains of Colorado.

E. W. GRAVES

In August of 1925 I made a trip by auto to eastern Colorado. While there I spent a few days botanizing in the mountains. My time was limited and I only had the privilege of spending two nights and a part of five days in the higher mountains. While the Pteridophytes collected were very limited, I did collect more than a hundred different species of flowering plants. Being August, the spring flowers of the lower valley were mostly past blooming, but in the higher valleys and on

the mountain sides near the snow there were many beautiful flowers in bloom, as it was just spring-time to them.

There is a good automobile road up Boulder Canyon to Nederlands, where it leaves the canyon and climbs in the direction of Long's Peak from the south, and ends some 4,000 ft. below the peak, which towers more than 14,000 ft. above sea-level. Near the terminus of this road the University of Colorado has established several substantial buildings, where laboratory work is carried on.

Another road runs up Thompson's River through Estes Park and crosses the divide at 11,500 ft. and runs around the other side to Grand Lake, a noted summer resort. This road extends around the north side of Colorado's highest peak.

In these high altitudes we find the spring flowers and fall flowers blooming together, as the season is so short. Here were Mertensias, Aquilegias, Gentians, and Solidagoes, all blooming at the same time. The beautiful blue *Aquilegia azurea*, which, I think, is Colorado's state flower, was quite rare in the parts I visited.

Five gentians were found by me, but the little *Gentiana heteropetala* was very dainty and quite rare. It was the smallest of the gentians I found. The few flowers on the tender stalk were not more than a quarter of an inch in diameter, and the tallest stalks were only five or six inches high. I found it only in the swamps and under spruce trees. Here also were two orchids, *Ibidium* (*Spiranthes*) *strictum* and *Habenaria stricta*. Most of the gentians chose the open meadowlands and grassy mountain-sides. *Gentiana frigida* grew nearly a foot tall at 10,000 ft., but at 12,000 ft. it grew only three or four inches high. It, with *Silene acaulis*, was about

the only flower found at 12,000 ft. altitude. Between 9,000 and 10,000 ft. the largest number of flowering plants were found. Here the open places were blotched with white and red Castillejas, or the Indian paint brush, as it is sometimes called. But the most beautiful flower to me was the fireweed, *Epilobium angustifolium*. Its beautiful purple flowers were seen from 7,500 to 10,000 ft. *Epilobium Hornemanni* was found around University Camp, but it was past flowering.

The mountain avens, *Sieversia turbinata*, was a pretty little flower growing near the snow-banks at Milner's Pass, 11,500 ft. altitude. With it in the moist soil just below the snow, grew *Senecio petrocallis*, the dandelion ragwort, also *Sibbaldia procumbens*, *Oreobroma pygmaea*, and *Blitum capitatum*, the last looking very much like a small prince's feather of cultivation. All these flowers growing below the snow-banks were very short and in full bloom.

It was rather surprising to find so few ferns. On this trip I only found seven in all. Even those were by no means common. *Cystopteris fragilis* was met with more frequently than any other. I found it in the valleys, also at the higher altitudes. It was the only fern found at 12,000 ft. altitude. Like *Gentiana frigida*, *C. fragilis* grew much smaller at 12,000 ft. than at 7,500 ft. near Boulder Falls. *Woodsia scopulina* was the next most commonly met with. I found it around Boulder Falls in several places, also at Nederlands higher up the canyon. It was much smaller at Nederlands than at Boulder Falls, owing perhaps to its growing in a drier location. *Dryopteris Filix-mas* was found growing at Boulder Falls, but not plentiful. I hunted in vain for it lower down the canyon in some of the ravines that open into the canyon from the south. I found it there

in 1908 on a former trip I made to Colorado, but search as I would up and down those ravines, I could not locate a single plant. In 1908 I found *Pteridium aquilinum* var. *pubescens* growing along those side ravines. There were great thickets of it standing higher than my head. On this last trip I found a few plants of it, but they were not the large healthy ones I found on my former visit. On rocks just above Boulder Falls I found *Polypodium hesperium* and *Cryptogramma acrostichoides*. Neither fern was plentiful and I found them nowhere else.

I only spent an hour on two different occasions around the falls. If I had explored farther back, I might have located other ferns, but I expected to find them plentiful when I got up in the damp forests at 9,000 or 10,000 ft. But I was greatly disappointed, as I found no ferns except *Cystopteris fragilis*. I waded through swamps, over wet moss and fallen logs in the open places among spruce and found plenty of plant life—several species of *Pyrola, Gentiana, Castilleja*, and two kinds of orchids, and many other flowering plants. I searched in the open grassy meadows, spending several hours, hoping I might find *Botrychium Lunaria*, but that was not to be my good fortune. That fern has been found around Pike's Peak, and no doubt it grows around Long's Peak. There were noisy brooks flowing among forests of spruce and other trees. There were lakes along whose borders grew great patches of Gentians among the grasses. There were great boulders and rocky walls that I explored, but I found no ferns except *Cystopteris fragilis*. I was certainly disappointed, for I expected to find several kinds of ferns in the damp meadows and swamps, or along the babbling brooks, which were fed by the everlasting snows above.

There is quite a contrast found in botanizing in the Colorado mountains and in the mountains of Alabama

and Georgia. In the southeast, if one explores rocky cliffs he is sure to find one, or often three or four varieties of rock ferns. If he wades a swamp or two, he may find a half dozen kinds of the larger ferns and often in great masses. In Colorado I walked miles along rocky cliffs and spent hours wading swamps and walking through forests without finding a single fern. I wandered for miles through the grassy alpine meadows and among piles of rocks above tree-line, and discovered no ferns except *Cystopteris fragilis*. But this was a pleasant trip which repaid in grand and wonderful scenery.

BENTONSPORT, IOWA

Recent Fern Literature

Dr. Christensen has published a study of the systematic position of *Polypodium vulgare*. He argues that it ought not to be placed, as in the past, by the character of free veins alone and concludes, from a consideration of all characters, that it belongs to a small group which is not very closely related to the free-veined species which have usually been associated with it in the sub-genus *Eupolypodium*. Rather it belongs with certain tropical (and especially Mexican and Andean) species of the sub-genus *Goniophlebium*, of which *P. plesiosorum* may stand as a representative, and with which *P. vulgare* is connected by forms with intermediate and inconstant venation.[1]

In the summer of 1928 Dr. Maxon went to Europe in connection with work on the fern flora of Jamaica; he has written pleasantly of his visits to various institutions

[1] Christensen, C. On the Systematic Position of *Polypodium vulgare*. Dansk Bot. Arkiv 5: 1–10, figs. 1–9. 1928.

abroad. Jamaican ferns are historically important because the first New World species to be described came from the West Indies and a considerable proportion of them from Jamaica. At the British Museum is the collection made by Sir Hans Sloane in 1687–89 and many later collections; at Kew is an unrivaled wealth of historic material; and at Stockholm and Berlin are the original specimens of Swartz, author of the first comprehensive flora of the West Indies. Dr. Maxon studied at all these places and also visited Dr. Christensen at Copenhagen. His paper is illustrated with several photographs.[2]

Mr. Mousley has published his annual report of his outings. This year (1928) ferns play no very great part in it. He did, however, find a station for *Botrychium angustisegmentum* which extends its range in Quebec sixty miles northward; and he gives notes on various other species.[3]

W. A. Anderson, Jr., has published a paper on the ferns of Tennessee, copies of which, he kindly informs us, may be obtained on request from T. C. Lowry, Director of University Extension, Box 4218, University Station, Knoxville, Tenn. We hope later to have a more extended account of this work.

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[2] Maxon, W. R. Studying Ferns in European Herbaria. Expl. and Field-Work Smithson. Inst. in 1928: 109–114, figs. 94–99. Washington, 1929.

[3] Mousley, H. Notes on the Birds, Orchids, Ferns, and Butterflies of the Province of Quebec. Can. Field Nat. 43: 93–99. 1929.

Shorter Notes

FURTHER OCCURRENCES OF THE ALLEGHANY CLIFF-FERN.—The relative of *Woodsia scopulina* D. C. Eaton which occurs in the Allegheny mountain region has until recently been definitely recorded from but two localities, one in Buncombe County, North Carolina,[1] and the other in Monroe County, West Virginia.[1, 2] Four additional ones can now be placed on record.

This fern was actually first discovered by E. C. Townsend in 1897, on White Oak Mountain, in Polk County, North Carolina, as pointed out by D. C. Peattie.[3] In 1927 it was found on Peters Mountain, near Narrows, in Giles County, Virginia, by Professor P. D. Strausbaugh, of West Virginia University.[4]

During a brief vacation in early June, 1929, Mr. J. E. Benedict, Jr., accompanied me on an auto trip through the mountains of Virginia, and we obtained the *Woodsia* at two new stations. In attempting to ford Laurel Creek just north of the village of Broad Ford, in Smyth County, we got water into the motor, and after being hauled out, left the car drying in the sun and explored the near by shale cliffs. About a hundred feet above the road a small colony of this fern was discovered, its associates being *Woodsia obtusa, Cheilanthes lanosa*, and *Asplenium platyneuron*. A few days later, on visiting a shale cliff north of the main highway 1½ miles west of Covington, Alleghany County, a much larger colony of it was found. Here it was accompanied by some stunted *Cheilanthes lanosa* and large mats of a *Selaginella* of the *rupestris* group, along with a number of endemic flowering plants, such as *Trifolium virginicum*.

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[1] AMER. FERN JOURN. **9**: 1. 1919.

[2] AMER. FERN JOURN. **16**: 92. 1926.

[3] Journ. Elisha Mitchell Sci. Soc. **44**: 117. 1928.

[4] Private communication.

Instead of being excessively rare, then, the Alleghany Cliff-fern is fairly wide-spread in the southern Blue Ridge and Appalachian physiographic provinces. So far as known it occurs only near the summits of high, west-facing cliffs of gneissoid or shaly rocks, where the soil reaction is slightly to moderately acid. Specimens from the new stations have been deposited in the U. S. National Herbarium, the Gray Herbarium, and the Virginia State Herbarium at Charlottesville.—EDGAR T. WHERRY, *Washington, D. C.*

SEED VERSUS SORUS.—We have received the following letter from Mr. Dobbie:

In Vol. 19, No. 1, of the "Fern Journal" there is a footnote about my using the term "seed" in connection with ferns. In my book, "N. Z. Ferns," page 15, is the following passage, "I have been tempted to use the botanical term 'sori' when alluding to the fructification of ferns, but, in a popular work the arguments in favor of the older word 'seeds' seems to me unanswerable. As defined in modern dictionaries it is exactly applicable—'That part of a plant which contains the rudiment or embryo of the future plant.' Stormonth, 1884 edition. Nine hundred and ninety-nine people out of a thousand do not know the meaning of 'sori' (the botanist possibly being the solitary exception), but they understand what is meant by 'seeds.' This is a popular work, written for the nine hundred and ninety-nine majority." To quote J. H. Fabre in his "Life of a Grasshopper," page 69, "Convinced as I am that barbarous terms are only a cumbersome impediment to science."

The following incident when writing this book may interest you. I asked a hundred people if they knew the meaning of "sori;" they all answered "no," and a university professor added, "Well, Dobbie, it's a good many weeks since I had one, but it was jolly painful."

Sorus is derived from the Greek, meaning "a heap," "seed" from the Latin "satus, to sow." I certainly think the latter the better definition.

In Webster's dictionary, modern edition, "seed" is defined as "The substance, animal or vegetable, which Nature provides for the reproduction of the species."

This is rather a rigmarole, but it will explain why I agree with Fabre in considering botanical terms as a cumbersome impediment to science. I believe they deter many from studying botany.

Yours sincerely,

H. DOBBIE.

We are glad to have this further explanation of Mr. Dobbie's usage, unfamiliar to us in America; and the playful professor's quip about sori has surely added something to our enjoyment of life. It is worthy of that prince of botanical punsters, the late C. T. Druery; we can only say in answer that it may be better to have sori, however painful, than to run too much to seed.

Mr. Dobbie's complaint against technical terms is a rather common one. No doubt the use of such terms may be overdone and degenerate into mere pedantry; but much of the complaint against them rests on a lack of understanding. They have a real and indispensable use. That this is so may be readily understood by recalling how many of them have made their way into everyday speech—telephone, telegraph, locomotive, automobile, for instance. These are quite as classical (Greek and Latin) and quite as "barbarous" as any scientific term; yet no one boggles over them. The reason is that they provide accurate names for things which would otherwise be without a name. When Alexander Graham Bell worked out the principle of the telephone, he produced something new to human experience and therefore not accounted for in existing language. It needed a name and he made one for it. So, when a botanist first worked out the true nature and mode of action of the fructification of ferns, he also found something new and nameless; and the needed names—sorus, sporangium, spore—were duly made for its component parts. Each of them means, very definitely, one thing and one only; "seed," in Mr. Dobbie's sense, means half a dozen different things, and

a long explanation (like Mr. Dobbie's) is needed to tell, in any given case, which of the half dozen is referred to. There, in a nutshell, is the reason for technical terms—exactness and brevity.

Mr. Dobbie receives some distinguished, if indirect, support from Prof. Schaffner's use, in this number, of the term "flower" for the cone of *Equisetum*. But this is open to the same linguistic objection. "Flower" has meant for generations (to quote Jackson's authoritative "Glossary of Botanical Terms," edition of 1916): "an assemblage of organs essential for fertilization, as stamens and pistils, with some protecting envelope." This does not apply at all to the fructification of *Equisetum*. Prof. Schaffner's rather revolutionary definition of flower may prove scientifically correct; but, if so, it would be better to coin an entirely new name for the new idea rather than to attempt to change the meaning of a word already definitely understood to mean something quite different. To do that is likely merely to confuse and weaken language.—C. A. W.

WILSON'S PROMONTORY, VICTORIA NATIONAL PARK.—I left Melbourne on the 8:15 A. M. train Monday morning, bound for Welsh Pool, a town on the Southeastern line. I took a motor-boat from there to Sealers' Cove, an inlet on the eastern side of the Promontory. The Promontory contains about 100,000 acres, and is established as a permanent sanctuary for the preservation, under natural conditions, of the fast disappearing flora and fauna of Australia (Victoria). The country is mountainous, with deep gullies intervening. With regard to the flora, more than 600 species of native plants have been found, and about 40 have been introduced.

From Sealers' Cove I explored the gullies in search of ferns and found most of the species recorded in the Vic-

torian Census, from the giant tree ferns to the tiny filmy ferns. As the track winds through the gully from the beach to the gap, the luxuriance of the embowered fern vegetation is delightful to behold. At first the Polypodiums were most noticeable, growing on trees, logs, and on the ground, but higher up the track they were not so luxuriant.

I counted in all about 50 species, but they are strictly protected.—ALLAN MACCASKILL, JR., *Coleraine, Victoria.*

AFIELD FOR FERNS IN SUSSEX COUNTY, NEW JERSEY.—May 24–26 was an open season for ferns, mosses, birds, and flowering plants in Sussex County, New Jersey, this year. Even the rocks, fields, and hills were included. The occasion was the annual Branchville Nature Outing of the Torrey Botanical Club, held in conjunction with the Sussex County Nature Club, and with the collaboration of sundry members of the American Fern Society and the Sullivant Moss Society and various other clubs of like nature. The headquarters was at the Pines, which was filled to capacity with seventy-eight registered for two days and one hundred and twenty-nine altogether present on Saturday.

The program included an all-day automobile expedition led by Dr. Kummel, State geologist for New Jersey, and covering many miles of country under his expert guidance. The bird enthusiasts started in early on Saturday with a sunrise walk, with the help of special hotel alarm service about 5 A. M. Many woke who were not called.

The first fern trip, consisting of a party of one, took place about sunrise also and was in the nature of a scouting expedition in preparation for the leadership of larger parties later. It yielded eighteen species, including *Asplenium ruta-muraria* and *Pellaea atropurpurea*, but

with some surprising omissions in the way of species which are expected in almost every woodland.

After breakfast, a more thorough canvass by a larger group brought seven more species to light, all within the forty acre range of wooded and ledgy grounds of the Pines. A special effort was made to discover some of the small botrychiums, but despite concerted effort, with the whole group on hands and knees, searching under hemlock and in thicket none were found at that time. In the afternoon, however, on another round of the same territory, when nothing was expected, the matricary grape fern suddenly obtruded itself in the range of vision, along a beaten path twice trod before. The first tiny plant was succeeded by a score more, some considerably larger, and ranging from some so small that they suggested *B. simplex* to triangular forms, like *B. lanceolatum*, and one slender one, simulating *B. onondagense*. With the later finding of *Dryopteris dryopteris*, the total number had risen to twenty-six in a half mile walk.

However, the list was still lacking in some of the common swamp species, so that later in the afternoon a special search for a good swamp was undertaken. We found it, a few miles distant, knee-deep in mud under elms; we added the royal fern to our list, and on the more elevated portions, where tree roots held together a firmer substratum, *Dryopteris spinulosa*, *D. cristata*, and *D. Boottii* were readily identified. As a matter of record, it may be noted here that plants of these four species were taken up and installed in appropriate situations along the attractive little lake on the Pines property.

The complete list of thirty species is appended. From the absence of several common species, it seems likely that the total will rise to thirty-five or more after more intensive search is made.

Finding Asplenium Ruta-muraria
(Photograph by C. A. Gramet)

Asplenium platyneuron; A. Ruta-muraria; A. Trichomanes
Athyrium angustum
Camptosorus rhizophyllus
Adiantum pedatum
Cystopteris fragilis
Dennstaedtia punctilobula
Dryopteris Goldiana; D. intermedia; D. Dryopteris; D. hexagonoptera; D. noveboracensis; D. Thelypteris; D. marginalis; D. spinulosa; D. Boottii; D. phegopteris; D. cristata
Matteuccia Struthiopteris
Onoclea sensibilis
Polystichum acrostichoides
Pteridium latiusculum
Polypodium vulgare
Woodsia obtusa
Osmunda cinnamomea; O. Claytoniana; O. regalis
Botrychium matricariaefolium; B. virginianum

—R. C. BENEDICT.

HOW HAVE YOUR HART'S TONGUE PLANTS SUCCEEDED? —So far the reports regarding the naturalization of hart's tongue have told of failure. The plants set out have persisted at most over one winter, and some have not even survived the first winter. Only a few reports have come in so far, and it is hoped that others may have had better luck to report. However, please send in word whatever the result. In one case there has been reported success in establishing in a garden two sets of plants, one group from Mr. Ransier and another of spore-grown plants from the Brooklyn Botanic Garden. Mrs. A. C. Barnes, of the Barnes Foundation, Merion, Penn., has sent in a fine photograph showing a thrifty group of plants, with spore-bearing leaves. Her method of

growing these plants is told in the following paragraph, quoted from a letter.

"We mixed a good quantity of leaf-mold with the soil in planting the ferns and also broke up some limestone in rather small pieces and scattered them over the bed. Also for the winter we gave a heavy mulching of leaf-mold and although one bed (that of the photograph) has a northwest exposure, the ferns survived. The ferns that you sent me are planted in a more protected place with a southeast exposure and have done equally as well as the others with the same cultural methods."

FERNS OF NEWBURYPORT, MASSACHUSETTS.—The following thirty-two ferns are to be found growing in Newburyport, Massachusetts, and its vicinity. The colony of narrow-leaved chain ferns at Seabrook was discovered by Alvah Eaton. It probably is the most northerly known location for this fern in the United States.

The maidenhair spleenwort is very rare, two colonies only being known. The Clinton's fern, the *Woodsia obtusa*, and the climbing fern are also very rare in this vicinity, one colony only of each being known.

Fronds of the broad-leaf spinulose fern (*Dryopteris dilatata*, var. *americana*) found by the writer at Newbury, Mass., in 1923, may be seen at the Gray Herbarium, Cambridge, Mass. This is surely the rarest fern of eastern Massachusetts.

One colony only of the broad beech fern is known.

1. Polypody. *Polypodium virginianum.*
2. Bracken. *Pteridium latiusculum.*
3. Narrow-leaved Chain Fern. *Woodwardia areolata.*
4. Common Chain Fern. *Woodwardia virginica.*
5. Ebony Spleenwort. *Asplenium platyneuron.*
6. Maidenhair Spleenwort. *Asplenium Trichomanes.*
7. Silvery Spleenwort. *Athyrium acrostichoides.*

8. Lady Fern. *Athyrium angustum.*
9. Christmas Fern. *Polystichum acrostichoides.*
10. Crested Fern. *Dryopteris cristata.*
11. Evergreen Wood-fern. *Dryopteris intermedia.*
12. Marginal Fern. *Dryopteris marginalis.*
13. Spinulose Fern. *Dryopteris spinulosa.*
14. Broad-leaf Spinulose Fern. *Dryopteris dilatata* var. *americana.*
15. Clinton's Fern. *Dryopteris Clintoniana.*
16. Common Bladder Fern. *Cystopteris fragilis.*
17. Blunt-lobed Woodsia. *Woodsia obtusa.*
18. Rusty Woodsia. *Woodsia ilvensis.*
19. Hay-scented Fern. *Dennstaedtia punctilobula.*
20. Sensitive Fern. *Onoclea sensibilis.*
21. Ostrich Fern. *Pteretis nodulosa.*
22. Royal Fern. *Osmunda regalis.*
23. Interrupted Fern. *Osmunda Claytoniana.*
24. Cinnamon Fern. *Osmunda cinnamomea.*
25. Climbing Fern. *Lygodium palmatum.*
26. Maidenhair. *Adiantum pedatum.*
27. Long Beech Fern. *Phegopteris polypodioides.*
28. Broad Beech Fern. *Phegopteris hexagonoptera.*
29. Oak Fern. *Phegopteris Dryopteris.*
30. Marsh Fern. *Dryopteris Thelypteris.*
31. Massachusetts Fern. *Dryopteris simulata.*
32. New York Fern. *Dryopteris noveboracensis.*

—EDWARD H. CLARKSON, *Newburyport, Mass.*

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We get occasional news of the Ransiers. Their pilgrimage has now taken them from Florida, where JOURNAL readers last heard of them, across the entire southern tier of states to California, and thence northward up the Pacific coast. Stops have been made at many points of interest, fernwise and otherwise—Havana Glen, Alabama; New Orleans; Roosevelt Dam and other points in Arizona; Catalina Island, Cali-

fornia; the great redwood groves; and, at last accounts, Crater Lake, Oregon. It is good news for us that the Ransiers are to share some of their experiences with us, in the form of articles and pictures for the JOURNAL. One article is already in the copy-drawer and will appear in the next number.

The field meeting at Harper's Ferry, in conjunction with the Wild Flower Preservation Society's Washington Chapter, as announced in the JOURNAL, was duly and successfully held. We had a good attendance, good, if somewhat torrid, weather, and a very good time. A detailed account of the meeting will appear in a subsequent number.

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E. J. WINSLOW C. A. WEATHERBY

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American Fern Journal

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American Fern Journal

VOL. 19 OCTOBER–DECEMBER, 1929 No. 4

Round about Florida for Ferns

NELLIE C. KNAPPEN

As nothing has appeared in the AMERICAN FERN JOURNAL on Florida ferns since 1916, an account of the ferns seen on a recent motoring trip through that state may be of interest. In all, over forty species were collected, many of these reaching their northern limit in Florida.[1]

The first fern of interest other than the thatch of the grey polypody on the wide-spread arms of the live oaks, was the venus hair fern thickly clothing the old gate at St. Augustine, and lining the walls of the moat about Fort Marion. Intermingled were countless small leathery once-pinnate ferns, which proved to be greenhouse ferns of Asiatic origin—*Cyrtomium falcatum*. These formed a charming contrast to the delicate texture of the venus hair.

On the drive to Daytona by the shore road the grass fern and golden polypody were found growing on palmettos.

Along the Indian River the huge fronds of the leather ferns were seen everywhere, and *Blechnum serrulatum* was equally abundant.

Pteris longifolia and *Anemia adiantifolia* were growing in coral rock along Brickell Road, Miami, part of the

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[1] Dr. Maxon of the United States National Herbarium was kind enough to identify some of the puzzling species of ferns.

[Volume 19, No. 3, of the JOURNAL. pages 77–112, figs. 5 and 6, was issued Sept. 23, 1929.]

old Brickell Hammock, and in great profusion in the old quarry at Chapman Field. The Boston and sword ferns, several species of Dryopteris, and *Pteridium caudatum* were found in the hammock of the Deering Estate at Cutler. *Pteris longifolia* and *Anemia adiantifolia* grew much larger here in the forest than in exposed situations. In the wells and pits of the floor of the hammock were plants of *Asplenium dentatum*, the first spleenwort seen.

During the next two days Mr. Charles Mosier, naturalist of Miami, was kind enough to be our guide. Without his help and that of his trusty machete, we could never have penetrated to the heart of the dense hammocks where some of the rarer ferns hide themselves. At Royal Palm Hammock State Park ferns were growing in tropical luxuriance, though no rare species survived the devastating fire of a few years ago. We drove to Dewhurst Hammock, seventeen miles south of the Park on the Cape Sable Road, to see the beautiful plume polypody. A great live oak had fallen long ago, one of its branches rooting and forming a new tree. The polypody covered the whole fallen trunk with its arching streamers, flanked at either end by a beautiful plant of the strap fern. There was also some of the polypody growing on the live part of the tree. It is hard to describe the charm of this fern—the long ribbons 25 to 30 inches in length—the pinnae of which are so tightly curled during the dry season that they hold firmly leaves and bits of twigs and branches in their clasp—arching over like the spray of a fountain.[2]

[2] The material answers the description of *Polypodium Plumula* except for length of fronds. Many fronds were a yard long but these were already brown. Of two collected, one 26 inches long has 100 pairs of pinnae and one 28 inches long has 106 pairs. The sori are minute. There are scales along the midrib, and the venation is difficult to make out due to leaf texture, compared to *P. pectinatum*.

Growing by the roadside were tufts of a Pteris—blue-green in color with a very golden hairy rootstock, and scaly or hairy all the way from the base to the tip of the frond. These were very different in appearance to the *Pteris longifolia*. Three weeks later this was seen growing luxuriantly over the tombs and walls of the old New Orleans' cemeteries. This is *Pteris vittata*, a wanderer from another continent.

Visits were made to the famous Snapper Creek and Hattie Bower Hammocks, where *Adiantum tenerum*, *Dryopteris reptans* and *Asplenium dentatum* grew in profusion. In Hattie Bower Hammock were first seen the Halberd ferns, mostly *Tectaria minima*.

The following day, we drove out on the Florida keys, and, on Key Largo, entered the dense hammock to find, very soon, the charming southern climbing fern, *Polypodium Swartzii*. This was growing on a very smooth white-barked tree, *Drypetes diversifolia*, or Larger Guiana Plum. In this fern it is the rootstock that climbs straight up, throwing out to one or both sides the closely appressed fronds. The ruddy tone from the hairs of the rootstock and the vivid green of the thin fronds make a striking contrast to the white bark. This plant little suggests a fern.

The next exciting finds were in the limestone grottoes near Pineola in Citrus County, western Florida. Following Dr. Wherry's directions we soon came out of a wood road to a cleared place where were small rosettes of *Asplenium verecundum* and of *A. resiliens*, growing profusely on low rock ledges in the hot sun. In the rocky woodland near, the fern tufts continued and finally the grottoes were reached, where our efforts were indeed rewarded. Half a dozen different species of ferns were interwoven in intricate confusion, on the walls of the grotto, Curtiss, Asplenium, *Asplenium verecundum*, *A.*

Polypodium Swartzii

A. Young sterile fronds from simple rootstock, with reddish scales and hairs.

B. Small fertile fronds from short branches of main rootstock.

C. Mature specimen, long fruiting fronds from long hairy branches, the main rootstock grey and nearly smooth.

D. A very broad frond.

E. Fronds showing a typical form of variation.

abscissum, venus hair, *Pteris cretica* in a very simply palmate form, and the Florida walking fern. This fern, *Dryopteris reptans*, both here and in the Gainesville grottoes rooted constantly at the tips with a few erect fronds, while on the pitted floors of the southern hammocks all those found had erect fronds only. When, with difficulty, this delicate fern is disengaged from the confused mass, its pattern is charming. Starring this drapery of ferns were extremely large bladed, long stalked fronds of the halberd fern. In another part of the grotto was an abundance of much smaller halberd ferns, which were probably younger plants of *Tectaria heracleifolia*, though they looked different.

After driving through Istachatta to Nobleton, a mile's walk brought us to the McDonald Quarry where there was a very large lime sink full of stagnant water. The overhanging cliff was clothed throughout its twenty or thirty feet of height with overlapping fringes of venus hair fern and long streamers of *Asplenium heterochroum*. The effect of the rich green pendant fronds so narrow, yet a foot or more in length, was striking. Growing at the top of the cliff was the first pectinate polypody seen. It was a surprise to find that the Adiantum in all these grottoes was *A. Capillus Veneris* and not *A. tenerum*.

The following day at Gainesville, Dr. Williamson, chemist with the Tung Oil Corporation, directed us to the adjacent fern grottoes. We drove west on the Newberry road, past extensive Tung plantations, pink with blossoms, turning in at a gate on the left, eight and one-half miles from the town. This proved the most interesting of the grottoes. We approached by a rock-strewn, wooded hill-side with pectinate polypody growing on every rock. The hill-side was covered also, alas, by nettle through which we had to pick our way. Everywhere in the moss on the walls of the grotto was *Dryopteris rep-*

tans, binding together a drapery of the various lacy spleenworts, many of which were very long fronded. Near the base grew *Pteris cretica*, and along the sides the pendant streamers of *Asplenium heterochroum*. The simply pinnate *A. abscissum* stood out plainly amid the finely divided ferns. There was some *A. resiliens* here, and nearby on the floor of the wood grew *A. platyneuron*, thus bringing the number of Aspleniums here to six. *A. verecundum* grew in small, whorled, closely appressed rosettes, quite iridescent, on one wall, while on the facing wall its fronds were nearly as long as those of *A. Curtissii*. The latter is, however, coarser, of a thicker texture, and a different, darker green.[3]

As Mr. Harper wound up his account[4] of the Pineola Region by advising fern lovers to seek it out before its destruction, we were thankful to see so many rare ferns, in such profusion, thirteen years later despite adjacent quarrying operations.

A distance of two thousand miles was covered during the two weeks in Florida, nearly half of the time being devoted to fern collecting. Though we brought back over thirty species new to us there are still in Florida many ferns which we look forward to finding on other trips, other years.

A list of the more important ferns collected follows:

Anemia adiantifolia
Acrostichum aureum
Acrostichum daneaefolium
Polypodium Plumula
Polypodium pectinatum
Polypodium aureum
Polypodium Phyllitidis
Polypodium Swartzii
Vittaria lineata
Pteris longifolia

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[3] The drawing of *Asplenium ciecutarium* in Eaton's Ferns of North America, Vol. 2, Plate 56, is so exactly like material which was collected, that we supposed we had found this rare fern till Dr. Maxon set us right.

[4] AMERICAN FERN JOURNAL 6(3): 68–81, April–June, 1916.

Pteris vittata
Pteris Cretica
Pteridium caudatum
Adiantum Capillus Veneris
Adiantum tenerum
Blechnum serrulatum
Asplenium platyneuron
Asplenium resiliens
Asplenium heterochroum
Asplenium abscissum
Asplenium dentatum
Asplenium verecundum
Asplenium Curtissii
Tectaria heracleifolia
Tectaria minima
Dryopteris normalis
Dryopteris patens
Dryopteris floridana
Dryopteris gongylodes
Dryopteris reptans
Nephrolepis exaltata
Nephrolepis biserrata
Cyrtomium falcatum

WASHINGTON, D. C.

The Flowers of Equisetum

JOHN H. SCHAFFNER

(Continued from page 82)

As is to be expected the calyx of *Equisetum* is subject to much and extreme fluctuation. In *E. praealtum* the typical condition is to have a completely sporogenous calyx sheath and only rarely is it entirely without sporangia, while at the other end of the evolutionary series the reverse condition is the rule. In *E. arvense* the calyx is normally completely sterile and only occasionally does it bear one or more sporangia. In this species, out of 51 cones gathered at random, 48 had no sporangia on the calyx, while three had one or more sporangia each.

The physiological gradient, on which differentiation or character expression depends, may not develop at an equal rate on opposite sides of the determinate reproductive bud; and thus one side of a whorl may be ahead of the other in expression on the transition zone. Such cases are fairly common in *E. arvense*, where they may be easily studied. A shoot of this nature is shown in figure 3. The last sheath below the calyx proper is half

leaf sheath and half calyx. In the calyx proper, several of the segments in line with the calyx segments below have sporangia while the opposite side is normally sterile. The basal calyx may occasionally be quite intermediate between a leaf sheath and a typical calyx. Another interesting occurrence is frequently met, in that the first whorl or even the second one above the calyx may have all the stalks of the sporophylls completely united. In such cases the gradients do not move properly and sheath heredity is thus still in evidence in the sporophyll whorl. Such a case is represented in the diagram of the cone in figure 7. One somewhat similar example was seen in which the sheath segments showed partial peltate sporophyll characters on top but developed no sporangia on the lower side except in one segment which had a single sporangium also on the lower side along with several on the upper side. There may also be considerable internodal development between the calyx and the first sporophyll whorl or even higher up.

In the tabulation below are represented the actual conditions found in six normal cones of *E. praealtum* and six of *E. arvense*. Much greater diversity is present and these are given merely to indicate the more common types. In *E. praealtum*, for example, one cone had 25 sporophylls in its largest whorl while a small sterile cone had but six sporophylls in its largest whorl. It will be seen that the common fluctuation of normal cones of *E. praealtum* is, including the calyx segments and the sterile sporophylls at the apex, from about 275 to 125 and of *E. arvense* from 200 to 75.

The figures of the two plates will give a general idea of the nature of the calyx and of the cones in *E. praealtum* and *E. arvense*. The explanations of each figure will indicate the particular characters illustrated. The diagrams are constructed from actual examples and the

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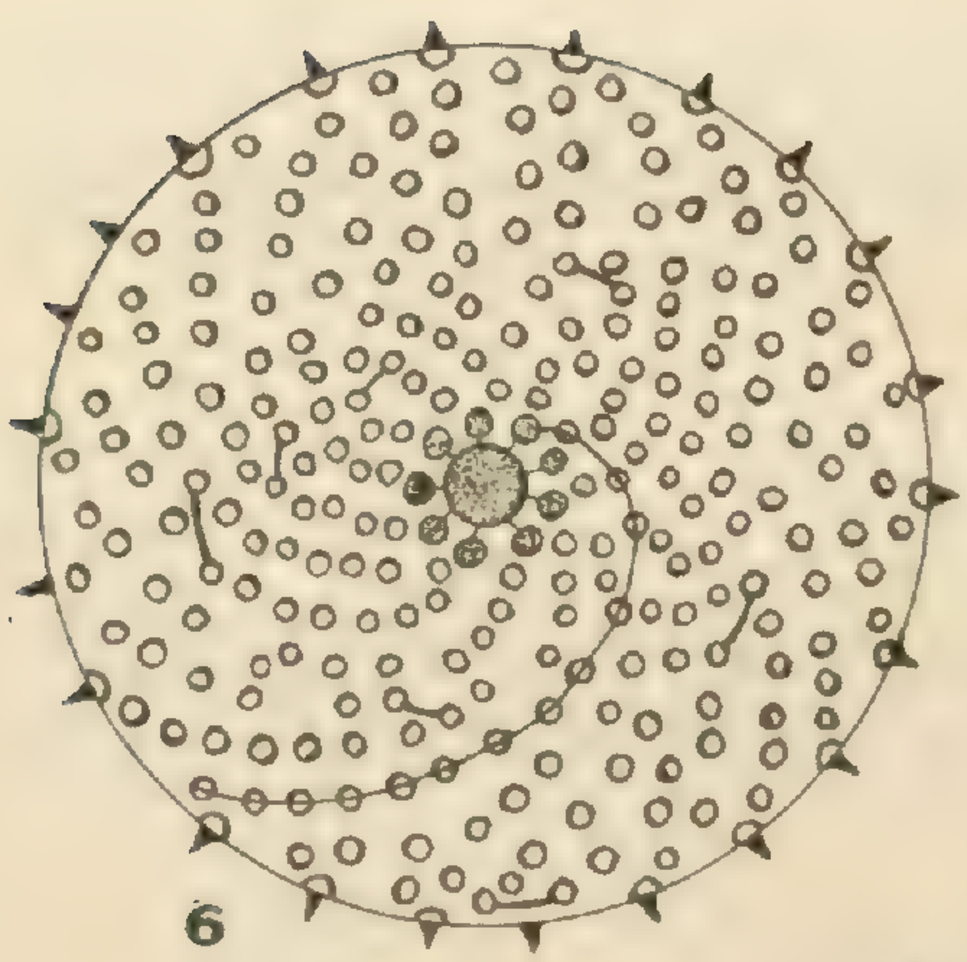
TABLE 1.—Normal cones of *Equisetum praealtum* (Nos. 1–6) and of *E. arvense* (Nos. 7–12), showing the numbers of whorls and the sporophylls in each whorl. The top whorl in *E. praealtum* is sterile or semisterile.

Whorl	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12
18th							1					
17th							5	3				
16th							7	6	3	2		
15th		10					7	8	5	4		
14th	9	10	7				8	9	6	6		
13th	11	11	8				9	9	7	7	2	
12th	13	11	10	9			10	9	7	7	4	3
11th	15	12	11	9	6		11	9	8	9	5	4
10th	16	14	12	10	7	8	12	9	9	10	5	4
9th	17	15	14	13	8	9	12	10	9	11	7	4
8th	19	16	15	14	10	10	13	10	10	9	8	5
7th	19	18	15	16	12	11	14	10	10	10	9	6
6th	18	20	16	16	12	11	13	10	12	9	8	7
5th	19	19	16	16	13	11	13	11	12	10	8	7
4th	21	20	16	17	14	11	14	11	12	12	9	7
3rd	20	20	16	18	14	12	16	12	13	13	10	7
2nd	23	21	18	19	15	14	16	12	14	11	9	7
1st	23	23*	22	20	18	15	14	11	12	11	9*	7
Calyx segments	24	22	22	20	20	16	14	12	12	10	9	7
Total sporophylls and calyx segments	266	262	218	197	149	128	209	171	161	151	102	75

* Cones with two calyx whorls.

sporophylls of each whorl are placed as nearly as possible in their natural positions. With such exceedingly variable structures, this is difficult to do. The outside circle represents the calyx and the small circles the sporophylls. In *E. praealtum* the large, central, dotted circle represents the vegetative apex and the small dotted circles the sterile or semisterile sporophylls of the top whorl. Two



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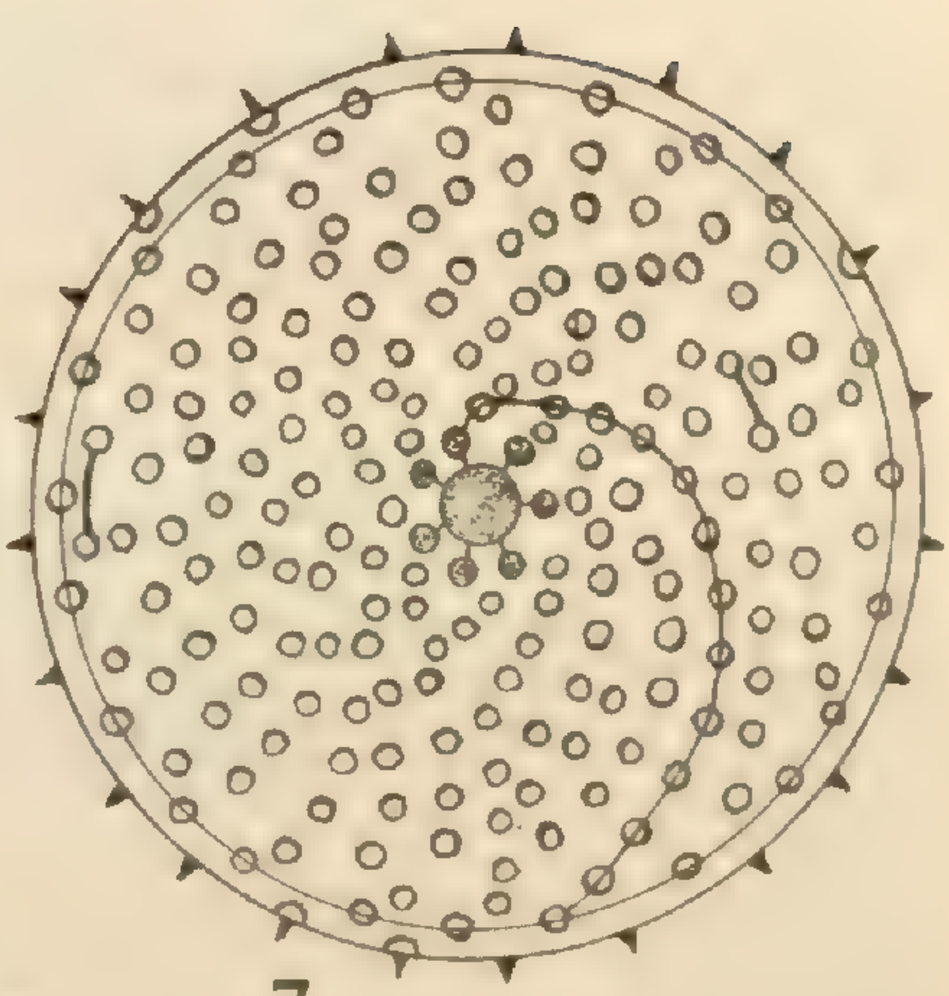

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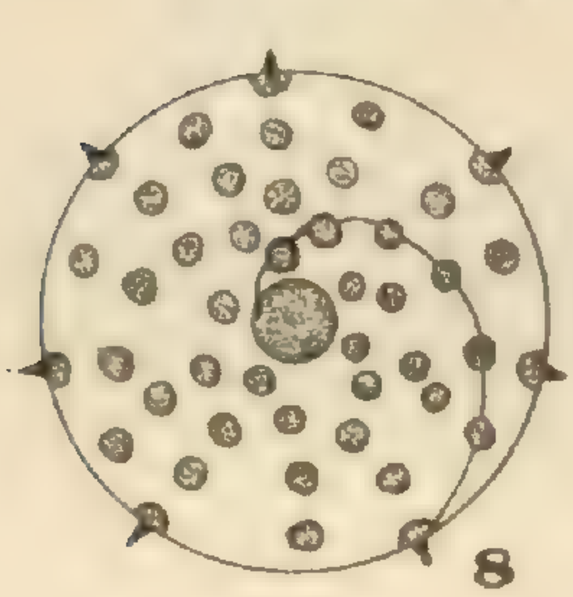

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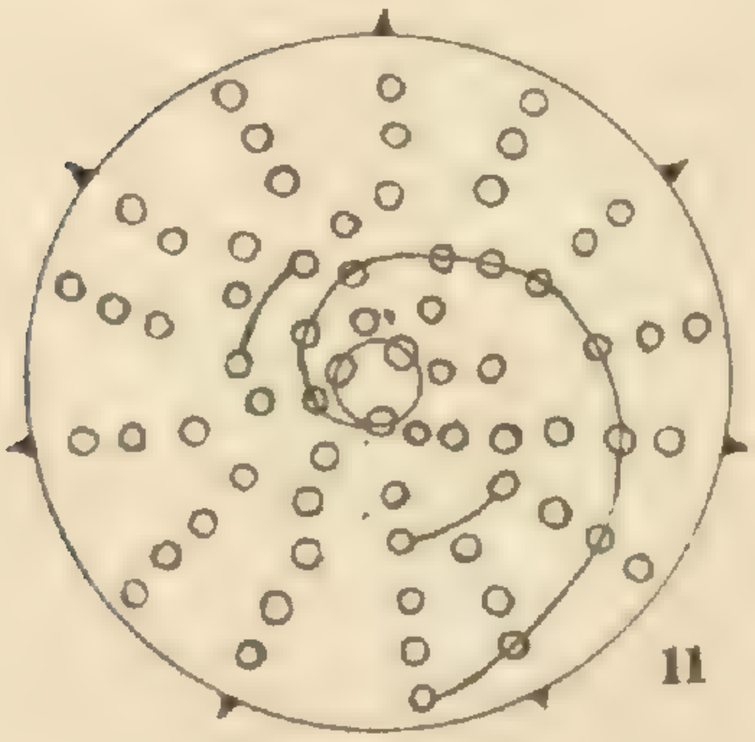

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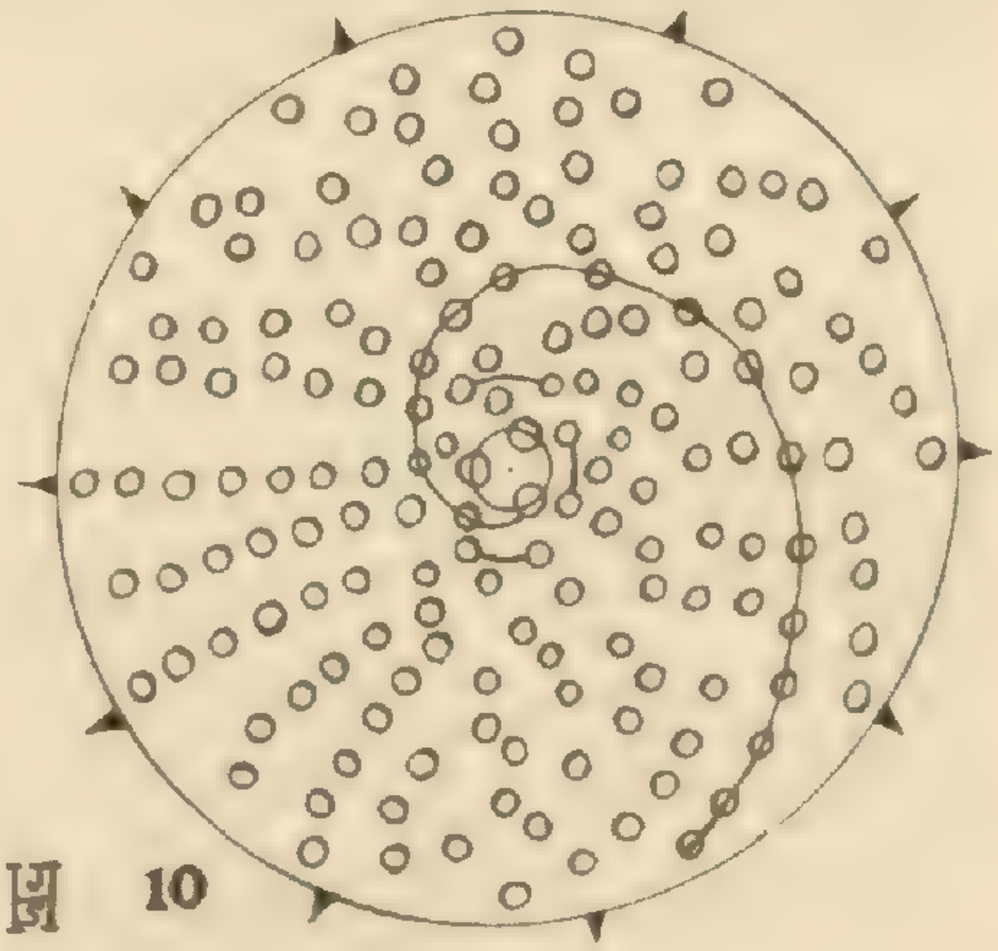

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or more sporophylls joined by a line indicates that they are distinctly double or are united by their stalks. The spiral drawn from the center to the circumference indicates the general spiral arrangement of the sporophylls, which is plainly in evidence in spite of the irregular numbers in contiguous whorls. In the cone itself the regularity becomes more evident through the presence of broad and double sporophylls, which compensate for the irregularities.

The evolution of the Equisetum flowers, as represented by living species, therefore, shows the following distinct movements from a lower to a higher condition:

1. The fluctuation between vegetative and reproductive shoots becomes rare in the highest species while in some of the lower species it is very common and represents a closely intergrading series.

2. The movement is toward a more prompt determination of the reproductive axis and the final elimination of the vegetative point, as well as the reduction in number of sporophylls.

3. The lower cones have much chlorophyll, which remains until the spores are matured; in the highest species the chlorophyll is practically absent even in the young stage.

4. The perianth or calyx advances from a normally sporangium-bearing structure in the lower species to a sterile structure in the highest.

5. There is a definite progressive evolution of a peduncle, the highest species having a very prominent development of this organ.

6. There is a decided evolution in the texture of the cone and its stalk so that the dimorphism with the vegetative shoot becomes very pronounced in this respect in the highest species and at the same time there is a more

extreme and rapid condition of decay after the spores have been shed.

7. The evolution of the time and place of origin of the flower also shows a prominent advancement. In the lowest species the flower develops on old aerial shoots, while in the highest its development is completely geophilous on a highly specialized shoot, the reproductive structures being complete when the flower emerges from the ground.

EXPLANATION OF PLATES 8 AND 9

Fig. 1. *Equisetum arvense.* Calyx and first whorl of sporophylls, the calyx with 5 sporangia, 4 of which are shown.

Fig. 2. Normal, completely sterile calyx of *E. arvense*, showing 11 calyx segments.

Fig. 3. Peduncle of *E. arvense*, showing unequal functional condition in terminal bud which produced a normal leaf sheath on one side and a calyx on the other. The calyx itself shows 3 sporangia in line with the calyx portion of the leaf sheath below.

Fig. 4. Normal calyx of *E. praealtum*, showing typical sporangia on the upper side.

Fig. 5. Calyx of *E. praealtum*, showing a completely sterile condition except in one segment which bears a single sporangium.

Fig. 6. Diagram of typical cone of *E. praealtum*, showing 9 semi-sterile sporophylls at the tip, 234 normal sporophylls, and a calyx of 22 segments, 5 of which have no sporangia. The dotted central circle represents the vegetative point. Certain sporophylls have their stalks grown together.

Fig. 7. Diagram of cone of *E. praealtum* in which the calyx is nearly sterile and the following cycle of sporophylls is in the monadelphous condition. The calyx has 22 segments, only 5 of which bear single sporangia.

Fig. 8. Diagram of small semi-sterile cone from a lateral branch of *E. praealtum*, with 38 sporophylls and 7 calyx segments, each with one or more sporangia.

Fig. 9. Diagram of minute, completely sterile cone of a side branch of *E. praealtum*, with 10 sterile sporophylls and

a calyx of 6 segments, each with a minute sterile sporangium.

Fig. 10. Diagram of typical cone of *E. arvense* with 161 sporophylls and a calyx of 10 segments.

Fig. 11. Diagram of small fertile cone of *E. arvense* with 68 sporophylls and a calyx of 7 segments.

COLUMBUS, OHIO

The Cemetery Ferns of New Orleans

H. E. RANSIER

After long familiarity with central New York's varied and beautiful rich fern region; after tramping through Canadian Hart's Tongue country; after collecting ferns in Alaska, sometimes with my feet in the sea while reaching for them on rocks above my head; after snatching huge leather fern fronds near Florida's southern tip, in spite of the swarming hordes of mosquitos; after collecting fragile bladder ferns on mountain tops 13,000 feet above sea-level; after searching for ferns in Death Valley 300 feet below sea-level (unsuccessfully); after a trip into Havana Glen, Alabama's unique ravine where the hybrid *Asplenium ebenoides* has been found to grow more freely than in any other place on the globe; after all this and in spite of having an inkling in advance of what was in store for me, it was in the great city of New Orleans that I experienced a genuine new thrill, that of seeing ferns fairly take possession of two cemeteries located in the heart of the city, with but high brick walls to favor them.

New Orleans has a population up towards the half million mark, is over 200 years old and much of the land is below high water mark of the Mississippi River. Levees are a city block thick at the base, fifty feet thick

at the top and five feet or so higher than flood-level. These levees have cost some eleven million dollars. Eight giant pumps raise seepage and sewerage. Cemeteries of the usual type were out of the question from the start, so all interments were in vaults of various kinds, above ground. Girod Cemetery, the first to be visited, is across the street from a large freight depot and has been in continuous use for a century and a quarter and more. Both white and colored people are buried there.

It was early May. We entered and the gates closed behind us. A kindly old Welsh lady met us, explaining that she was taking her brother's place for the day and readily gave us the freedom of the premises. On our left is the keeper's shelter, overhead the branches of a moderate sized tree, and on the right, pomegranate blossoms are conspicuous amid the thick shrubbery. Straight ahead was the open drive, now not much more than a path. Monuments, mausoleums and unnamed types of places of burial stand shoulder to shoulder, except for narrow paths to the right and left. Some structures are of brick, some of stone, some of marble, others of concrete and many hidden by a coat of plaster. All show unmistakable age. Modern "perpetual care" provisions were developed too late to apply here, so much of the place is overrun with weeds, vines and ornamental shrubs run wild, except where relatives of the dead voluntarily provide for care of lots.

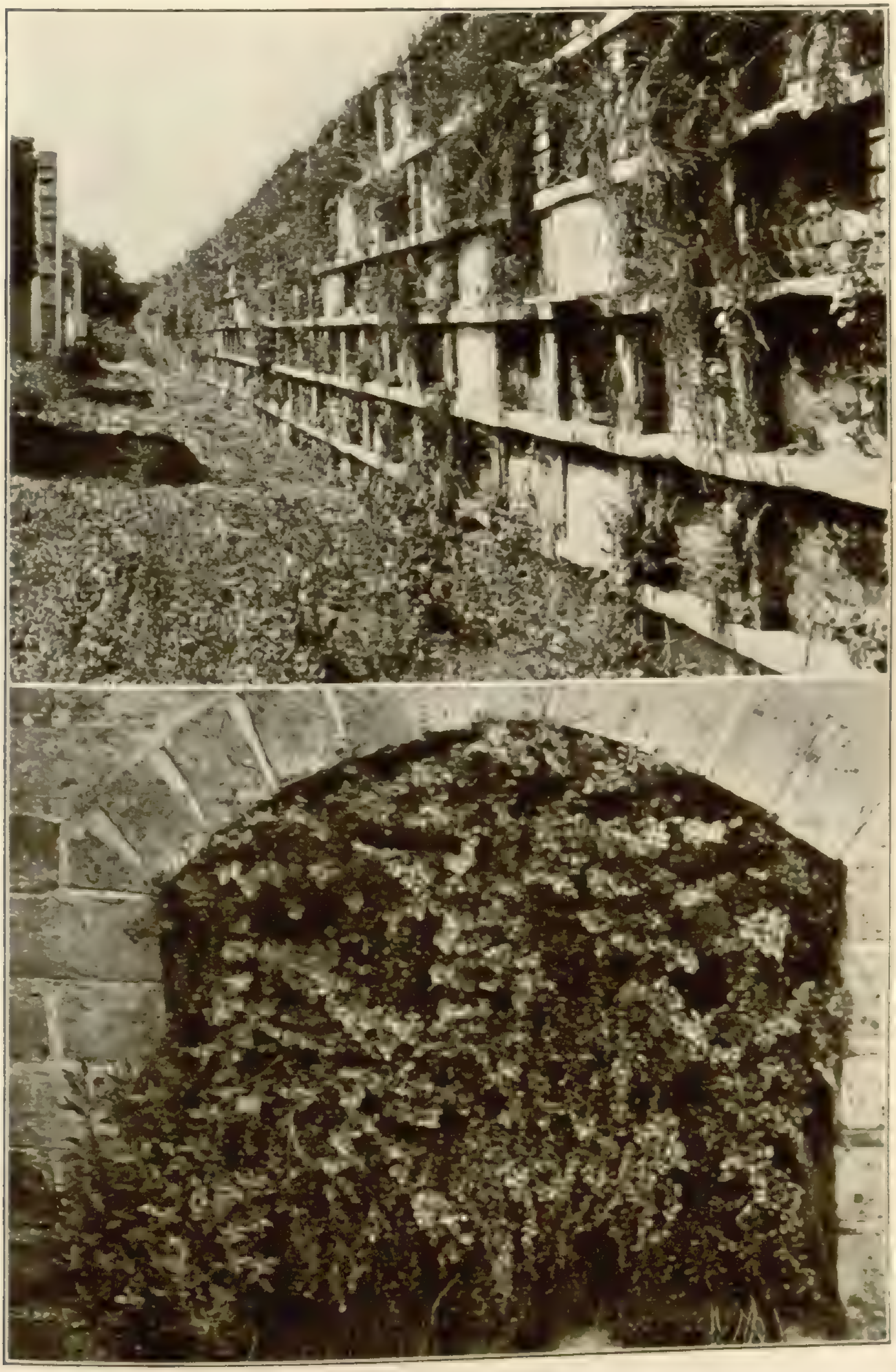
How strange to find ferns here, not struggling for existence, but apparently in the most favored of places in all creation, growing upon brick walls, upon marble vaults, upon plastered or concrete structures. Wherever a piece has been chipped off or loosened or a crack has appeared, there ferns are at home and thriving, perfectly well and happy, thank you! Time has worked its changes upon most of the structures and the changes

have favored the ferns, always. One tomb was overrun with and buried under a vigorous growth of poison ivy. When asked if he knew what it was, the caretaker said: "Oh, yes! But the owner won't allow it to be cleared off, for fear repairs will have to be made, if it is disturbed."

Two colored men were puttering around, throwing handsful of grass and weeds into the handiest opening, usually some caved in crypt or unoccupied vault. Lime and whitewash were their favorite weapons apparently, as they had a pail of one or the other in their hands usually. Far over to the right, along the outer wall, were long continuous sections, six tiers high, of burial niches—vaults or tombs probably used by the poorer classes and negroes, the equivalent of a "potter's field." Two kinds of ferns were especially prominent, *Pteris vittata,* up to three feet in length, and *Adiantum Capillus-Veneris.* The latter often grew in dense mats, though possibly not of maximum size. Naturally both excelled in favored shady places.

St. Louis Cemetery is the size of two city blocks, completely surrounded by old city streets, yet its high brick wall affords a sense of seclusion and propriety. Not as old as Girod, of better class, better cared for, presumably used by whites only, it is in no wise "modern." French and Spanish names abound, foreign touches everywhere, peculiarities of other lands woven in with customs of our own. The most modern thing I recall was the marble structure of an Italian fraternal order, circular, with many niches prepared to receive the remains of members, but in so crowded a section that it was impossible to get any suitable picture of it.

Of course it is probable that the ferns in both of these old cemeteries originated as escapes from greenhouse decorations brought in, but their presence is evidently



Above: Vaults with Growth of Ferns. Below: Adiantum Capillus-Veneris in the Opening of a Vault.

Pteris vittata on Cemetery Vaults.

not at all unwelcome. What finer offerings could be desired—voluntary, evergreen, permanent and refined.

In striking contrast is a fine modern cemetery, in which stand long rows of well spaced, expensive, polished rock and marble mausoleums with perfect lawns and landscaped grounds but *not a fern in sight.*

Recent Fern Literature

A GENETIC ANALYSIS OF VARIATION IN THE HART'S TONGUE.—An expert taxonomist has recently described several new species of Iris from Louisiana, basing them on striking differences in flower color and shape, and on general habit, which they manifest when compared with the species heretofore recognized from that region. An expert geneticist who has recently raised the second (F-2) generation of a cross between two Iris species native in Louisiana, has found among his seedling cultures a group of new forms which differ even more widely in color, etc., than the taxonomist's species. Thus among the grandchildren of a reddish brown type (*I. fulva*) and a blue type (*I. foliosa*) there are purple, clear yellow, cerise and pink flower types, as well as clearly marked associated differences in size and shape of the flower, habit of plant, etc.

These facts are offered for their bearing on the old problem: How may the word species be defined? Are the wild types really species, or must they labor under the cloud of the bar-sinister until it can be experimentally determined whether they are fertile, true-breeding and self-perpetuating? If the latter is found to be the case, does that prove that they are not hybrids? If the artificially raised types are found to come true to seed and to be self-sustaining under natural conditions,

would that allow them admission to the rank of species? One thing is certain; experimental breeding is the only method by which any definitive evidence can be obtained.

In Irma Anderson-Kotto's comprehensive study of the cultivated varieties of the hart's tongue fern, carried on at the John Innes Horticultural Institute, London, we have an excellent example of the application of the experimental method to the solution of a complicated problem of fern variation. (*Hereditas* **12**: 109–178; figs. 1–25; pls. II–V; 1929.) As is noted in this paper, "the evolution of the new types of *Scolopendrium vulgare* probably coincided with the fern craze of the latter century and the beginning of the present, when natural garden and extensive cold house culture flourished, especially in England." Apparently the original variation among wild plants was not very noteworthy, as it is noted that: "The abundance of wild plants which I have seen in the woods and along lanes in Cornwall have all been of the *vulgare* type, or in some cases, *vulgare crested*," or they "varied slightly in width or shape of frond or showed slight undulation of the lamina." In any event, through intercrossing, a great variety of different forms came into existence until there were over two hundred and fifty named varieties, more than the number of wild fern species in the United States.

Mrs. Anderson-Kotto's account of her work is so comprehensive that it is useless to try to give any adequate review of her whole paper, but some mention of the more noteworthy types described and of the writer's conclusions may be made. Incidentally a request is being forwarded for one or two extra copies of the article with the intention of placing these in the Fern Society Loan Library, deposited at the Brooklyn Botanic Garden.

The chief impression which an examination of the article gives is found in the bewildering variety of leaf

forms figured and described. The plain and simple tongue-like leaf of the wild type is shown to be capable of an extravagance of variation that must be seen to be appreciated. Actually, however, when all the types are classified, they appear to fall mainly under a few categories, chiefly cresting, ruffling, dwarfing, which are expressed in an infinite series of combinations and types. There are no cases of pinnate division although in some of the ruffled forms, the margins are more or less lacerate, giving a pseudo-pinnatifid lobing.

Cresting or forking has been carried to an extreme that transcends the ready imagination. Picture a hart's tongue leaf which starts at the base as a narrowly linear shape, forking and reforking more or less indefinitely. As many as ten successive dichotomies were noted in some of the leaves depicted. Some crested types are foreshortened until the whole leaf is broadly fan-shaped. Between these two extremes exist all degrees and gradations of subdivision, but it appears that the different stages represent generally distinct and hereditable states, and that inheritance is usually on a simple three-to-one Mendelian basis.

Other differences have to do with modifications in the general shape of the leaf, of irregular warty thickenings of portion of the under surface. Some varieties are dwarfed until the leaves consist of little more than the regular basal lobes, and the mid-vein projecting as a spine-like process between two apical lobes. With the ruffling there are correlated lacerations and murications. In some forms the under-surface callosities are confluent to form distinct and complete secondary marginal ridges.

The most striking variations may be noted in the author's own words: "The remarkable fact is that types have arisen which are strikingly different from *Sc. vulgare in habit and depart from the specific and generic*

characters. Thus the extravagant type, to be described in family 1003 (fig. 26; pl. V), with its entirely *new type of sorus and habit* would have been given the rank of a new genus by the systematists, and might, owing to the position of the sori along the *practically naked branched stem* have occupied an important place in phylogenetic speculation, had we not known its origin. The characters are beyond doubt recessive to those of the *vulgare* type.

"The extravagant type occurring in another family (36/25 t. 9) may also be mentioned as being unique in respect to position of the sori, no such folded-back, double, pinna-like sori on the edge of the frond ever having been met with in ferns before. (Pl. III, B and Fig. 22G.)"

The following brief statement, also quoted from the original paper, may be of some special interest because of its simplicity and definite directions. There is nothing complicated about Petri dish culture, nor about the preparation of the agar, Knopf solution culture medium.

"The original plants used in these experiments (reference numbers 1–25) were obtained mainly from the collection of the late Mr. H. Stansfield of Manchester. To obtain hybrids of known parentage it was found convenient to use the transparent culture medium which had previously shown itself to be suitable for the rearing of prothallia. Spores were therefore sown on a thin film of agar-agar with Knopf's solution in Petri dishes under sterile conditions. Before the production of archegonia each single prothallium was transferred to a separate Petri dish. In order to ensure cross-fertilization when the archegonia were open the Petri dish was filled with Knopf's solution and prothallia with antheridia of the proposed male parent were added. Twelve hours is usually long enough to effect fertilization. The solu-

tion with male prothallia is then removed. The hybrid usually appears a week or two after, and when the root and cotyledon are well developed it is transferred to soil. The prothallium of *Scolopendrium vulgare* is at first either male or asexual. This stage is followed by a period of growth, after which archegonia appear at the usual place. When the archegonia are ready for fertilization the antheridia are as a rule empty. This applies to the normal prothallium, regularly formed and more or less heart-shaped. If the prothallia are grown on beyond this stage new lobes or outgrowths will develop and become covered with antheridia; in order to secure self-fertilization, therefore, prothallia may have to be kept for a considerable time. For the purpose of self-fertilization of single gametophytes the prothallia are therefore best transferred to soil after they have been cultivated separately in dishes and have grown to a considerable size. The pots must be covered with glass, and water must be given from above when the prothallia are ready for fertilization. In the experiments of which an account is given in this paper only a few gametophytes were self-fertilized, and these cases have been noted in the text. In all other instances the term self-fertilization has been used as in genetical experiments upon angiosperms, i.e., the gametophytes from a single sporophyte have been allowed to fertilize inter se. When no cross is mentioned it may be understood that the plant in question has been selfed.

"The soprophytes were grown in separate pots and raised in an intermediate glasshouse, part of them afterwards being kept in frames or planted out; all the plants of a family[1] have been grown under uniform conditions."

—R. C. BENEDICT.

[1] Here used to indicate a group of individuals of given descent, not in the technical botanical sense.

American Fern Society

FIELD TRIP, AUGUST 31–SEPTEMBER 2, 1929.—The trip announced in this JOURNAL, Vol. 19, No. 2, was taken as scheduled, with an attendance of eleven members of the American Fern Society, about the same number of members of the Wild Flower Preservation Society, and several guests.

The party assembled at the Shenandoah Inn, Harpers Ferry, during Saturday afternoon, and that evening Dr. Wherry outlined the plans of the proposed excursions for the two following days. With the aid of some excellent slides he kept everyone deeply interested in an account of the ferns that had been found in the vicinity. Outline maps bearing dots for recorded occurrences showed that the most notable ones are southern species here occupying northern extensions of their ranges. Dr. C. E. Waters commented on some of the rarer Aspleniums, mentioning particularly the differences in outline between the hybrid *Asplenium ebenoides* raised by Miss Slosson and the majority of the natural occurrences. Mr. Maurice Brooks exhibited fronds of *Asplenium gravesii* and of a very curious stiff, narrow form of *Polystichum acrostichoides*, which had this year fruited for the first time since brought under observation. Both of these came from the vicinity of his home, French Creek, toward the central part of the State. Mr. C. A. Weatherby also discussed some points brought out by the above speakers.

Sunday morning the entire party was stowed into the seven automobiles available, and the distance of five miles southwestward to Keys Ferry on the Shenandoah was soon covered. Here we went aboard a rather primitive ferryboat, and were poled across to the east shore (the river flowing northward at this point). A short walk

southward then brought us to the interesting series of cliffs, discovered by the late Dr. T. C. Stotler, an amateur botanist of Harpers Ferry. Here we saw a number of colonies of *Asplenium pinnatifidum*, some of them having a curious aspect, owing to the elongation of one or more of the lower segments of the frond, suggesting, in fact, *A. ebenoides*. It was remarked that if this form had grown in New England, it would have received a special name long ago. Other rock ferns seen comprised *Asplenium platyneuron*, *A. trichomanes*, *Cheilanthes lanosa*, *Cystopteris bulbifera*, and *Woodsia obtusa*. Then we proceeded to look for the prize of the occasion, the little *Asplenium* which had been named *A. stotleri* by Dr. Wherry[1] in honor of the discoverer of the locality. There was one particularly bold bluff of the hard greenish gray schist which underlies the hills at this point—known to geologists as Harpers Schist, and classed as pre-Cambrian in age—which toward the base was quite barren of vegetation. Scrambling up over rock ledges and fallen trees through one of the notches in the line of cliffs, we ultimately reached the summit, and on cautiously approaching the edge, a considerable abundance of this fern met our view. In all about twenty-five colonies of various sizes were counted, growing on the bleakest, most exposed ledges, in part where these overhung. No other ferns were associated with it, although in a few places elsewhere on the same rock-mass both *A. pinnatifidum* and *A. platyneuron* were observed. It was much too thick-textured and round-lobed for *A. bradleyi*, and the participants familiar with *A. gravesii* agreed with Dr. Wherry that it was distinct from that (the distinctness had recently been questioned by Mr. Graves[2]) but

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[1] AMER. FERN J. 15: 52. 1925.

[2] AMER. FERN J. 16: 49. 1926.

no one could recall having seen anything just like it elsewhere. As no photograph of this plant has ever been published, it seemed desirable to use one to illustrate this report. The weather having been exceedingly dry this summer, the plants were not in as good condition for this as might be desired, but Dr. Wherry had taken a photograph of the largest clump when adequately supplied with moisture in November, 1928, which is here reproduced as **Plate 12, Fig. 1.**

We next ascended a cool mountain stream, stepping from rock to rock among the tiny cascades, noting many clumps of *Polystichum acrostichoides* and *Dryopteris marginalis*, and a few plants of *Lycopodium lucidulum*, *Botrychium dissectum*, and *B. virginianum*. At one point the party halted to rest, while a few of the more active climbers went up the rocks and found a small colony of *Asplenium montanum*, along with several commoner rock ferns. Here and there along the way, also, were small clumps of *Camptosorus rhizophyllus*, the species which was the goal of this part of the trip. We ultimately reached the place where a vast series of ledges was completely carpeted with the Walking Fern, showing considerable variation in form and outline. A few plants of *Dryopteris spinulosa* variety *intermedia* were noticed in this vicinity, and then our attention was directed to another *Dryopteris* which could not be identified at first. When Mr. Weatherby saw it, however, he at once pronounced it *D. spinulosa* variety *fructuosa*,[1] calling attention to the fact that while it had much the outline of the species itself, there were glands not only on the indusia but even along the secondary rachises. This was apparently the first time this variety had been ob-

[1] *Dryopteris spinulosa* (O. F. Muell.) Ktze., var. **fructuosa** Gilbert, n. comb. *Nephrodium spinulosum fructuosum* Gilbert, List N. Am. Pterid. 37. **1901.**

Figure 1 (above), Asplenium Stotleri.
Figure 2 (below), Cheilanthes tomentosa.

served in the state of West Virginia. A few of the members wished to press specimens of this plant for their herbaria, and were somewhat uncertain as to how to get such large fronds within the compass of a single sheet. Dr. Waters helped out by demonstrating how, when one wishes to bend a fern frond back on itself, for pressing, an inch or so of the rachis may first be crushed between the fingers, and a bend can then be made in this crushed zone without fear of the rachis snapping so that the two portions would become separated.

Returning to the Ferry, we crossed the stream again and got into the automobiles for a trip a mile and a half further southwestward, across Snyder Hill. The Shenandoah River meanders around considerably in this vicinity, and the road soon descended the hill to its banks again. Here we left the cars, stopping to get drinking water at a neatly kept farm house, walked a short distance along an old mill race, and then ate our lunch. At one point along the mill race there grows the American representative of *Asplenium ruta-muraria*, now known as *A. cryptolepis*, this being one of the very few instances known of its occurrence on masonry (the two species being very dissimilar in this respect). It proved to be too badly injured by the drought, however, to yield a photograph.

The chief rarity to be sought at this point was *Cheilanthes tomentosa*, a southern fern here reaching its northernmost known limits.[3] Climbing the cliffs to a place of the same type as that occupied by *Asplenium stotleri*, although not so high, we soon found this plant, in one large and four or five smaller clumps. As a result of the dry weather, its fronds were mostly well rolled-up; but it is a sort of "resurrection-plant," and members of the party who took fronds along with them reported that

[3] AMER. FERN J. 16: 108. 1926.

on leaving these in water a few hours they opened up and looked fresh and green again. Dr. Wherry had photographed the large clump the preceding November, and it seems worth while to publish this picture also, so it appears as figure 2 on plate 12. The only other notable fern seen in this vicinity was some *Asplenium pinnatifidum* with unusually elongated fronds, which gave evidence of beginning to proliferate at the tips, like *Camptosorus*, though not making much of a success of it, because of the dry weather.

Thus far all of our searches had been made on siliceous rocks (except for the mortar-bound mill-race walls), so it was next in order to see what limestone rocks would yield in the same region. Taking the autos back past Keys Ferry and Millville, we continued across the main highway down into the valley of a small tributary of the Potomac River, adjoining the embankment of the B. & O. Railroad, about a mile northwest of Bolivar. Parking our cars near the pumping station where much of the water supply of Harpers Ferry is obtained, we walked up the valley of the stream. Here the drought was not quite so serious, and the lower limestone ledges, at least, were clothed with luxuriant growths of mosses and ferns. *Cystopteris bulbifera* was present in considerable abundance, while *Camptosorus*, *Asplenium platyneuron*, and *A. trichomanes* were much in evidence. Some years before Dr. Wherry had found a plant of *Asplenium ebenoides* in this vicinity, and although it had later disappeared, he hoped to be able to show the party another. This hope was fortunately realized. One rather poorly developed yet unmistakable plant was found in the midst of the parent species toward the base of a large mass of limestone, and its position was carefully located so that it could be watched in future years to see if it might not increase in size. It then seemed as if the object of the

trip had been accomplished, but just as we were about to leave Dr. Wherry discovered a second, far better plant, having fronds up to 26 cm. in length and 6.5 cm. in width. This was a most striking specimen of this curious hybrid fern, and excited much admiration among those who clambered over the rocks to see it. We then got back to the Shenandoah Inn in time to get rested up before partaking of a splendid chicken dinner provided for us.

After dinner many of the party rambled over to Jefferson Rock, passing en route through the old cemetery, where in a walled enclosure lies the body of John Harper, the founder of the town of Harpers Ferry. Here, extending out of these dry walls (as elsewhere through the town) there was seen much *Pellaea atropurpurea,* in green and thriving condition, in spite of the extreme dryness. Beyond this point, and somewhat nearer Jefferson Rock, we paused for a moment at the grave of Dr. Stotler. From the rock an impressive view of the Shenandoah River was had, the roar of its rushing waters among the great rocks of its bed being quite loud and deep, while off to the east for miles could be followed the course of the increased volume of the Potomac River, rolling on toward the Chesapeake, between the high wooded ridges of West Virginia, Maryland, and Virginia. We sat on and about the great rock through the vivid sunset, into twilight, and the succeeding darkness, inspired by the changing scenes about us and in the great valley below. Stars appeared and slowly assumed their full brilliancy as many pleasant subjects were discussed, a delightful finale of a very pleasant day. Before retiring a few of the party made a visit to Dr. Stotler's house, where his widow showed us his annotated books on ferns and the specimens he had collected, both pressed fronds and living ones, from the plants which he had brought in and which are still thriving in the garden.

Early Monday morning we started for the cliffs of Maryland Heights, across the Potomac opposite the town. The distance is not great, so we walked this time, and as we descended the steep streets many stops were made to admire the tiny but showy gardens of many of the houses, made colorful by China Asters, Zinnias, Celosias, and Petunias. On the walls quantities of *Pellaea atropurpurea* were in evidence, along with festoons of Kenilworth-ivy; several ruins of stone houses had billows of this vine hanging from eaves, roofs, and window frames, a rare and curious spectacle. The way up the mountain was hot and dusty, and most of the ferns on the exposed rocks were dry and shrivelled. Some large clumps were recognizable as *Cheilanthes lanosa*, but otherwise only common species could be seen along the road and trail. On the higher levels conditions were somewhat better, but it was only at rare intervals that we saw in sheltered places on the rock faces such species as *Asplenium pinnatifidum*, *A. platyneuron*, and *A. trichomanes*, and these were stunted and plainly showed distress due to lack of rain. From exposed ledges glimpses of the town across the river and of the mountains beyond could be had. The unseasonably hot weather made frequent stops to cool off necessary, so that we were unable to reach the summit of the ridge in the time available; however, the climb as far as we did go was appreciated by the party.

On returning to town, some of us climbed the "street" of steps cut out of the solid rock of the hill, which winds among picturesque little homes and their diminutive gardens. Harpers Ferry has an atmosphere that readily recalls memories of historical events leading up to and through the terrors of the Civil War, and it seems that but little change has taken place since those stirring times. The old substantial brick and stone houses with walls hidden under many coats of paint, and often

shaded by immense oaks, maples, tuliptrees, and locusts, add much distinction and character. The Shenandoah Inn, which housed all of our party in its many spacious rooms, dates well back into ante-bellum days, and we found much to interest us among the antiques preserved there. All too soon the time arrived for the party to break up, and a few at a time the members dispersed to their various homes, and another enjoyable meeting of fern enthusiasts had become a happy memory.

The members who attended were: J. E. Benedict, Jr., Mrs. G. E. Bill, Maurice G. Brooks, W. W. Eggleston, Miss E. L. Stone, H. W. Trudell, Miss M. G. Van Meter, Dr. C. E. Waters, Mr. and Mrs. C. A. Weatherby, and Dr. E. T. Wherry.—HARRY W. TRUDELL, *Philadelphia, Pa.*

We have received the following, apropos of the discussion of seeds and sori:

The antipodal punning of a New Zealand professor and an editor of the AMERICAN FERN JOURNAL (pages 102 and 103, last issue) over the pain of a sorī, prompts the more phonetically correct, but perhaps unforgivable, statement that I am sorĭ for both of them.—NORMAN TAYLOR, *Brooklyn Botanic Garden.*

With the above came this message: "Print the enclosed if you dare!" We accept the dare, but not wholly without apprehension as to what may come next.

New members:

Cota, Florenzio M., 3846 Cherokee, San Diego, Cal.
Perry, Mrs. Robert Dunlap, Brunswick, Maine.
Porter, Miss Mary N., Apt. A-7, Building no. 2, Greenridge Ave., White Plains, N. Y.
Saunders, Miss Helen E., 454 Seventh Ave., Brooklyn, N. Y.
Sharpe, Dr. M. R., Uxbridge, Mass.
Taylor, Mrs. H. B., 13 Babcock Ave., Silver Creek, N. Y.

Changes of address:

Gray, Rev. F. W., Marlinton, W. Va.
Kimball, Miss Laura F., 1515 L Ave., National City, San Diego Co., Cal.
Little, Elbert L., Jr., 612 North G. St., Muskogee, Oklahoma.
Platt, Miss Caroline M., 142 East 79th St., New York City.
Prince, Prof. S. Fred, Reed's Spring, Stone Co., Mo.
Rossberg, W. B., 95 Camp St., New Britain, Conn.
Walton, Rev. A. J., Fairmount, W. Va.

Mr. Robert A. Ware, 81 Pinckney St., Boston, Mass., offers to members, for postage, the following, all from Europe: *Asplenium Ruta-muraria, A. Trichomanes, A. viride, Blechnum Spicant, Ceterach officinarum, Cryptogramma crispa, Cystopteris fragilis.*

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EDITORS

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E. J. WINSLOW C. A. WEATHERBY

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American Fern Journal

VOL. 20 JANUARY–MARCH, 1930 NO. 1

New Tropical American Ferns--VII.[1]

WILLIAM R. MAXON

The two species herewith described as new are both from Trinidad, and are founded upon material included in the rich collections of pteridophyta received from Archdeacon A. Hombersley in recent years. The *Polypodium* is evidently rare, and is dedicated with much pleasure to its discoverer.

Polypodium Hombersleyi Maxon, sp. nov.

Subgenus *Eupolypodium*. Plants epiphytic, small, very delicate, solitary. Rhizome suberect, 2.5 mm. long, about 1.5 mm. thick, densely paleaceous at exposed apex; scales lance-oblong to broadly ligulate, acutish at apex, 0.8–1.1 mm. long, 0.2–0.3 mm. broad, thin but firm, light brown, strongly reticulate, sparsely long-ciliate (cilia 6 or 8 to a side, grayish, translucent, weakly curved, 0.1–0.2 mm. long), 6–10 cells broad below middle; cells mostly large and elongate-subrectangular, with very large lumina, the partition walls sharply sclerotic, the outer walls hyaline. Fronds several (about 6), subpendent, cespitose, 4–6 cm. long; stipes capillary, dark brown, very short (2–5 mm.), distantly grayish-pubescent, the hairs mostly geminate from an enlarged base; blades lance-linear, 8–11 mm. broad near middle, attenuate toward apex (extreme tip obtuse), abruptly reduced

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[Volume 19, No. 4 of the JOURNAL, pages 113–146, plates 7–12, was issued Jan. 3, 1930.]

at base, obliquely pinnatisect throughout, the rachis evident on both sides, capillary, atropurpureous, minutely geminate-pubescent beneath; segments about 20 pairs, alternate, the larger (characteristic) ones obliquely oblong, half their width apart, semiadnate and slightly decurrent, mostly rounded-obtuse at apex, 2–2.5 mm. broad, obliquely crenate-lobate nearly half way to the costa, the lobes subequal, 2 or 3 on either side; lower segments distant, mostly 1-lobed distally, the basal ones obovate, distinct, not vestigial; costae delicate, flexuous, immersed, evident by transmitted light; veins oblique, simple, solitary at base of lobes, terminating in large round hydathodes, the first distal one usually sterile; sori relatively large, 3–5 per segment, borne near the costa, terminal, slightly impressed; sporangia glabrous. Leaf tissue membrano-herbaceous, translucent, bright green, lustrous, minutely and distantly pubescent, the hairs mostly geminate from a branched glandular base, subpersistent, most noticeable over the concealed costa.

Type in the U. S. National Herbarium, no. 1,343,374, consisting of two plants and several detached fronds, collected from a mossy tree trunk at top of gully on the Blanchisseuse Road, $10\frac{1}{4}$ miles from Port of Spain, Trinidad, at an altitude of 660 meters, January 13, 1928, by Archdeacon A. Hombersley (no. 331). A single additional specimen (no. 331a) was collected at the same point by Mr. Hombersley on September 3, 1928. The collector noted as companion plants *Polypodium kaieturum* Jenman and *P. dicranophyllum* C. Chr.

The present species appears to be closely related only to *P. Randalli* Maxon, recently described[2] from Jamaica, which differs particularly in its linear or narrowly oblanceolate blades (5–8 mm. broad), its fewer segments (the lower ones vestigial and finally merging into a flexuous greenish rachis wing), its fewer lobes per segment, and its glabrous leaf tissue. Both are allied to the continental *P. Alfarii* Donn. Sm., which will be discussed separately.

[2] AMER. FERN JOURN. **18**: 46. 1929.

Tectaria trinitensis Maxon, sp. nov.

Fronds several, recurved-ascending, 40–85 cm. long. Rhizome decumbent, 2–6 cm. long, 1–2 cm. thick, conspicuously paleaceous at apex; scales tufted, subulate-attenuate, 7–12 mm. long, bright brown, membranous, somewhat erose-denticulate toward apex, glandular-ciliolate, the surfaces finely glandular-puberulous; stipes slightly shorter than the blades, yellowish brown, sulcate, lustrous, puberulous, scaly at base; blades 25–45 cm. long, 20–40 cm. broad, deltoid-ovate, subpentagonal, abruptly acuminate, bipinnate at base, otherwise pinnate, the rachis like the stipe; pinnae about 5 or 6 pairs below the obliquely pinnatisect tip, approximate, ascending; basal pinnae much the largest, 15–30 cm. long, 10–22 cm. broad, stalked (1.5–3 cm.), inequilaterally deltoid, strongly basiscopic (proximal pinnules about twice as long as the distal ones), the basal pinnules sessile or short-stalked, acuminate, obliquely pinnatisect at base or pinnatifid throughout, with the larger segments obliquely subpinnatifid, the smaller ones crenately lobed or merely crenate; other pinnules of basal pinnae simpler, subimbricate, semiadnate below, or finally decurrent and joined by an expanding wing; second pair of pinnae usually triangular-oblong, long-acuminate, falcate, inequilateral, obliquely pinnatifid throughout, or in large fronds pinnatisect or even fully pinnate at extreme base; upper pinnae gradually much simpler, partially or wholly adnate, obliquely pinnatifid, the lobes rounded-acutish; midveins slender, slightly elevated; ultimate veins very delicate, evident in drying, subprominulous beneath; areoles irregularly polygonal, variable in size, without included veins; sori small, relatively few and subdistant, round, the receptacles small; indusia small, thin, persistent, roundish, subpeltate, with narrow sinus, ciliate, pubescent. Leaf tissue delicately membrano-papyraceous, translucent, everywhere minutely crispate-puberulous beneath, septate-strigose above; segments copiously septate-ciliate throughout.

Type in the U. S. National Herbarium, nos. 1,343,166–167, representing a single complete frond with rhizome attached, collected on deeply shaded river bank, Cascade

Valley, St. Annes, Trinidad, October 11, 1927, by A. Hombersley (no. 326). Other specimens, smaller but otherwise in agreement, are at hand from the same locality (*Hombersley* 70); also two sheets of *Fendler* 154 from Trinidad, the precise locality not stated.

The relationship of *Tectaria trinitensis* is with *T. dilacerata* (Kunze) Maxon,[3] an abundant continental species ranging from Mexico to Panama, which, though variable, is well marked by its much more openly and deeply dissected foliage (the pinnules deeply cleft throughout, with mostly pointed or even attenuate segments), its scant or obsolete pubescence, and its deeply colored rhizome scales. The Fendler plants were distributed as *Aspidium cicutarium* Swartz, but except in their closed venation they bear no close resemblance to *T. cicutaria* (L.) Copeland, which is restricted to the Greater Antilles and is well characterized by its narrowly oblong to oblong-ovate blades, dull spongiose-herbaceous leaf tissue, and large sori, the indusia reniform.

WASHINGTON, D. C.

The Journey of Four "Ferniacs" to Coromandel

H. B. DOBBIE

My friends, aware of my absorbing interest in ferns, have softened the somewhat crude nickname of "maniac" to "Ferniac." Having arranged to meet a brother "Ferniac" at the Thames, a hundred miles from Auckland, I set off by service car at 8:30 A. M. The weather was fine, the road good, consequently we spun along at 30 to 50 miles per hour with but one hitch on the way. On reaching the Piako River which we crossed by a punt, we found six cars waiting to get

[3] *Aspidium dilaceratum* Kunze, Linnaea 23: 226, 300. 1850.

across (it was race day at Thames) which delayed us a quarter of an hour. On leaving the Great South Road at Bombay we passed through a prosperous farming country with no bush in sight, therefore, no ferns except for a few tree ferns about the homesteads, mamku, *Cyathea medullaris*, and of course the ubiquitous bracken. On reaching the head of the Firth of Thames we crossed the Hauraki plains, a vast stretch of absolutely level country, the roads as straight as an arrow. Crossing the wide estuary of the Thames River by a substantial bridge at Te Kopu we turned sharp to the left and followed a road that skirted the range of mountains that runs from Te Aroha to the end of the Coromandel peninsula, reaching the Thames township at 12:45 P. M. Here I met my brother "Ferniacs." Mr. Cameron and his two friends Jim and Wally.

The Thames is the ancient El Dorado of New Zealand. but now the gold mines are all abandoned; the steep hillsides are scarred with old workings and mounds of rubbish. Pollen St. has the imposing length of a mile. but there are many vacant allotments and empty buildings. How so large a population makes a living is somewhat of a mystery. There is practically no back country. just a range of barren mountains, the fishing industry and the engineering works of Price Bros. can hardly maintain the fifteen hotels. On asking the way to the newspaper office we were directed to turn up the street with a hotel at the corner, which did not help us much as there appeared to be a hotel at every corner.

After luncheon we piled into Mr. Cameron's whippet car, an excellent puller that never failed us on the whole journey. We took the road running due north along the sea beach with the steep mountains of the Coromandel Peninsula on our right, sometimes cutting through

a bold promontory. As the slopes were bare or covered with a stunted shrub the prospect was not promising for us. At every few miles we crossed a river rushing over a rocky bed that came from a narrow gorge in the mountains and provided a little level land which was dotted over with summer shacks and tents. At Puru we penetrated the gorge for a few miles, but found nothing of interest in the fern line. Tapu, the end of our excursion, 12½ miles from Thames, though looking a big place on the map, consists of a hotel, a garage, a store and about half a dozen houses. The journey back to Thames occupied an hour. We had a cordial reception from our Hibernian landlady, and had a very good dinner. She designated us as the "four madmen," for no one in their senses would go hunting ferns on race day, the one great day for Thames and its fifteen pubs.

At 6:30 A. M. next morning we again set out for Tapu. A narrow road branched off behind the hotel and plunged into a most forbidding looking gorge. In some places there was barely room for the road and the river; but the surface was fairly good and the gradient seldom exceeded one in ten. We passed but one house where the Cockey had evidently a hard struggle to make a living. A few miles up the gorge the scene changed suddenly, in place of hungry looking mountain slopes and rocky pinnacles we entered an enchanted forest, every foot of ground, excepting vertical rocks, clothed with luxuriant vegetation; countless tree ferns growing at every conceivable angle, great kauris standing above the other trees like giants. There was a profusion of ferns, but we did not see a single frond of the *Loxsoma*, the species for which we had planned this journey. Excepting the gully fern, *Cyathea Cunninghamii*, of which we saw several fine specimens, there was nothing rare.

Eventually we reached the summit of the pass at an altitude of fifteen hundred feet, flanked on either hand by rugged mountains rising to two and three thousand feet. My Tauranga friends declared that Coromandel was a poor country for ferns compared with the Oropi bush, and, as the guide who had promised to show us where the *Loxsoma* grew was, through sickness, unable to accompany us, we decided to return. I inquired of several young New Zealanders whom we met if they had seen the *Loxsoma*, our most notable fern, for it is a genus of but one species and found only in the north end of New Zealand. But, bless you! although their country is justly designated "The land of ferns" they could not name a single species out of the dozens that surrounded us. Nevertheless Mr. Cameron loaded the car with fine plants of *Asplenium falcatum* and *lamprophyllum*, *Polypodium pustulatum* and *Billiardieri*, *Nephrodium decompositum*, etc., until we looked like a travelling "Jack in the green." Near Thames Mr. Cameron got a good supply of our smallest leaved maidenhair, *Adiantum Aethiopicum*, for which he had been hunting all day.

We had one o'clock dinner at Thames, and then set out on our seventy-five-mile ride to Tauranga, going by Te Kopu, Hikutaia and Pairoa. We passed through rich pasture country with the mountain ranges on our left and then entered the Karangahake gorge. At one point we seemed to have reached a cul-de-sac. Black precipices on either hand rising a hundred feet or more confined the river to a narrow rift; the road had been blasted out of the solid rock; the railway which also penetrates the gorge plunges boldly into a tunnel and thus escapes the narrow pass. This is a country of abandoned gold mines, Karangahake, Wai-kino, May Queen. I can conceive nothing more dreary and desolate look-

ing—broken machinery, bridges, flumes, trucks, rust and destruction everywhere.

Waihi, which we reached after four o'clock, is still flourishing as some of the mines are producing gold. Here we inspected a fernery in an old shed where every plant was flourishing luxuriantly. Mr. Brown, the owner, is one of those born experts at growing ferns. For many miles we played hide and seek with the railway, crossing it innumerable times by over and under bridges and on the level. The road was excellent until we entered the Tauranga County, where the falling off was most noticeable, several lengths being abominable. In one place we started a hare which we followed for two or three miles. Though we were travelling at 35 miles an hour it kept ahead of us without any apparent effort, loping along in the most casual manner.

"That's nothing!" said Jim. "Wait till she puts her ears down and then you'll see her travel."

We reached our destination at 7:30 P. M. I had covered 300 miles in two days. Though we did not succeed in our quest it was a most interesting ride.

AUCKLAND, N. Z.

A Fernclad Bridge

H. B. DOBBIE

Once more seated beside Mr. Cameron in his powerful whippet car with "Rupe" in the tonneau we set off for for the Kai-mai ranges. After travelling a long way up the valley of the Wairoa River and crossing five large bridges we climbed to the forest clad mountains of the Kai-mai. Then, drawing the whippet to one side of the road we at once entered the virgin forest, walking over ground carpeted with soft filmy ferns, *Hymenophyllum*

demissum, or brushing aside the handsome crowns of the Sword fern, *Lomaria discolor*, that covered acres of the forest floor, shaded the while by innumerable tree ferns, Mamaku, Ponga, and Wheki, *Cyathea medullaris, dealbata*, and *Dicksonia squarrosa* and a few *Hemitelia Smithii*. Above these again the great forest trees towered to the sky. Then, entering a gully which gradually narrowed, we came in sight of a beautiful aerial bridge spanning the gully twenty feet above our heads. It was formed by the fallen trunk of a great rimu tree six feet in diameter. The span was over forty feet, quite level and smothered in filmy ferns, *Hymenophyllum scabrum*, and evergreen bushes, forming an easy footway four feet wide. The fronds of this beautiful fern, often two feet long, formed a soft carpet beneath one's feet.

Never have I explored a bush so rich in fern species. I counted no less than 58, including 11 filmy, 6 tree ferns, 5 *Pteris*, 10 *Lomaria*, 5 *Asplenium*, 2 *Hypolepis* and 6 *Polypodium*. In this gully I found *Lomaria nigra* for the first time on my own.

We also visited the "Fern Paradise," where the kidney fern, *Trichomanes reniforme*, covered the ground and fallen tree trunks as far as one could see with a green carpet of translucent discs.

Mr. Cameron found a dead Ponga, *Cyathea dealbata*, thirty feet high, the lower part covered with unusually luxuriant fronds of *Polypodium Billiardieri*. His astonishment that so robust a growth could find nourishment on the dry dead trunk was quickly explained; he wanted the exhibit for his fernery at Tauranga. With the first blow of his axe a fountain of water gushed out—there must have been more than a gallon! The phenomenon is well known to the bushmen, who aver that one need never be short of water in the forest where there are

dead pongas. We measured one young ponga, the fronds covered a circumference of 90 feet! A striking feature of this forest was the abundance of *Lomaria Patersoni;* the banks of a river were covered with the broad dark-green fronds.

Mr. Cameron has a theory that ferns are never plentiful where the nikau palm grows—a theory entirely his own. On catching sight of a solitary specimen high up the hillside, he was in two minds to clamber up and cut it down so that its seeds might not spread—poor innocent palm tree!

We passed close to the Kai-mai school house, a solitary little building perched on a bare hill. It appeared to consist of one room 12 feet by 8. The New Zealand Government does not neglect the education of the children.

We got back to Tauranga by 7 P. M. and were entertained after tea by wireless and gramophone. One day we went up the Pyes-pa road to see the forest of forked tree ferns. But the track was so awful that I can remember little else. It was not safe to travel faster than five miles an hour and even at that crawl it was a severe test to the mechanism of the car. We met no traffic—and no wonder.

AUCKLAND, N. Z.

Diagnostic Analysis and Phylogenetic Relationship of the Main Groups of Equisetum.[1]

JOHN H. SCHAFFNER

During the last few years, the writer has attempted to ascertain the morphological characters of *Equisetum* which are of the most importance in recognizing the species limits and in developing a correct view of the relationships and evolutionary movements within the genus. A continued study of the group has resulted in a better understanding of the problem with the resulting disposition of the subgroups and the orthogenetic arrangement of the species.

THE SECTIONS OF EQUISETUM, WITH LISTS OF THE SPECIES IN THE UNITED STATES

I. EQUISETA PRIMITIVA. Primitive Scouring-rushes. Aerial shoots perennial, large, with abundant whorls of branches; stomata in bands of several lines each; with a clear demarcation between sheath segments and teeth, the teeth mostly tardily deciduous or persistent; cones apiculate; lateral branches usually developing small cones abundantly. None in our region. (*E. giganteum*).

II. EQUISETA HIBERNA. Winter Scouring-rushes. Aerial shoots evergreen and much branched or little or not at all branched, tall and robust to rather small; stomata normally in single lines; with a clear demarcation between sheath segments and teeth, the teeth tardily or very promptly deciduous by an abscission layer and commonly carried at the apex of the stem as "pagoda caps"; cones apiculate; lateral branches sometimes developing cones. *E. laevigatum*, *E. praealtum*, *E. hiemale*.

[1] Papers from the Department of Botany, the Ohio State University, No. 240.

III. EQUISETA AMBIGUA. Ambiguous Scouring-rushes. Aerial shoots annual in regions of frost, the main stem little or not at all branched, rather small; stomata in single lines; with a clear demarcation between sheath segments and teeth, the teeth promptly or tardily deciduous by an abscission layer; sheaths ampliated and not discolored until extreme old age; cones without a point, rounded or merely acute at the tip. *E. kansanum, E. funstoni.*

IV. EQUISETA PUSILLA. Little Scouring-rushes. Aerial shoots annual or evergreen, small and slender, mostly less than 12-grooved, rarely branched but tufted; stomata in single lines; teeth not sharply differentiated from the sheath segments, persistent, no cleavage furrow being developed; sheaths ampliated, and usually loose, frequently campanulate; cones apiculate. *E. nelsoni, E. variegatum, E. scirpoides.*

V. EQUISETA AESTIVALIA. Summer Horsetails. Aerial stems annual, all green, with or sometimes without whorls of branches at the nodes; stomata in bands or scattered in the grooves; teeth persistent, no cleavage furrow being developed; cones without a point. *E. fluviatile, E. palustre.*

VI. EQUISETA HETEROPHYADICA. Spring Horsetails. Aerial stems annual, the fertile shoots with little or no chlorophyll at first, yellowish or brownish in color and later developing whorls of green branches or soon withering; sterile shoots usually much branched; stomata in bands or scattered in the grooves or sometimes nearly absent from the fertile stems; teeth persistent, no cleavage furrow being developed; cones without a point and the basal calyx usually without sporangia. *E. silvaticum, E. pratense, E. telmateia, E. arvense.*

OBSERVATIONS ON EVOLUTIONARY MOVEMENTS BETWEEN AND WITHIN THE GENERAL SECTIONS

The EQUISETA PRIMITIVA, whether they form but one or two species as Baker concluded or six as Milde supposed, must be regarded as having mutated but slightly from the ancient ancestral species from which all of our modern Equiseta have presumably been derived. This ancestral species was a member of a great group of plants still existing in Mesozoic time. This supposed species was the only one which escaped the general destruction of the group and probably had much the same characteristics as our present *Equisetum giganteum* L. with its long-growing perennial shoots, its abundant whorls of branches, and numerous apiculate cones. In addition it probably had long, ampliated, green leaf-sheaths with persistent teeth. From this ancestral species a line branched off which showed two marked advances; the aerial stems became annual and the tip of the cone lost its prominent point. The species of this series, comprising the last two sections recognized above, retained the persistent teeth and did not greatly change the mode of distribution of the stomata. These plants constitute the group usually called the EUEQUISETA and which are often regarded as a subgenus or even a genus in contrast to the remaining groups called HIPPOCHAETE. The distinctions which were supposed to separate the two groups have mostly disappeared with a more detailed knowledge of the species. The advance from the lower section, EQUISETA AESTIVALIA, to the higher, or EQUISETA HETEROPHYADICA is shown by the development of a decided dimorphism between the fertile and sterile shoots and by the early, geophilous development of the flower, which is usually completely developed by early spring and thus comes to maturity in a few days after breaking out

of the ground. The culmination species of the EUEQUISETA is *E. arvense* although *E. telmateia* is a parallel culmination more extremely specialized in some characters even than *E. arvense*.

From the EQUISETA PRIMITIVA, with their bands of stomata and nodal branch whorls, a second series is segregated, the main characteristic of which is the development of single lines of stomata. This series falls into the three sections, EQUISETA HIBERNA, EQUISETA AMBIGUA, and EQUISETA PUSILLA. As might be expected. the lowest species sometimes have the stomata in bands of two rows each, sporadically.

The EQUISETA HIBERNA retain the primitive perennial aerial shoot and the apiculate cone. The lowest species. *Equisetum myriochaetum*, apparently is branched nearly as abundantly as the species of the EQUISETA PRIMITIVA and the branching is progressively reduced until in the two highest species there is rarely any branching the first year and none or only sporadic branching later, although the branches may bear little cones rather abundantly much as in the EQUISETA PRIMITIVA.

The EQUISETA AMBIGUA are a direct side branch from the EQUISETA HIBERNA and much like them except that they have annual aerial stems and non-apiculate cones, hence the name "ambigua."

The EQUISETA PUSILLA are another series which connect with the lower EQUISETA HIBERNA but must have been separated quite early in the evolutionary history, there being no direct, living transition species. They are characterized by the retention of the primitive, apiculate cone, by having no well-marked differentiation between the sheath segments and teeth and no abscission, and by the reduction in size and simplification of the aerial shoots which rarely show any branching but may be

prominently tufted. The lowest species has practically annual aerial shoots while the rest are evergreen. The culmination species of the whole HIPPOCHAETE series is *Equisetum scirpoides.*

The progressive movements in the different series are very interesting. If *Equisetum myriochaetum* is included with the EQUISETA PRIMITIVA, with which it shares the large abundantly branched aerial shoots, the most important advance has been the change from bands of stomata to single lines of stomata. If it is included with the EQUISETA HIBERNA it becomes the lowest member of that section and its primitiveness is indicated by the abundant whorls of branches. The movement through the EQUISETA HIBERNA is then a successively greater elimination of the branch whorls until *E. praealtum* and *E. hiemale* are reached in which branches are normally developed only the second season and then sporadically. There is also a progression toward a more perfect abscission of the sheath teeth and these are very generally carried on the tip of the plant as "pagoda caps" in both *E. praealtum* and *E. hiemale.* A very striking change is seen in the internodal ridges. The lower species of the section have transverse bands of silex or single rows of tubercles up through *E. praealtum*, but the culmination species, *E. hiemale,* has advanced to the condition of a slight doubling of the internodal ridge by developing a double row of tubercles and a deep central groove in the sheath segment. The importance of this advance will be evident when it is learned that the same movement appears in three other sections independently.

The section of the EQUISETA AMBIGUA contains only the two closely related species, *Equisetum kansanum* and *E. funstoni.* They seem to be an offshoot from the

E. ramosissimum—E. laevigatum complex. Probably *E. kansanum* was derived from *E. laevigatum*, and *E. funstoni* from *E. kansanum*. The change is to the annual aerial shoot and the reduction of the point on the cone. The two species are also usually smaller and, as would be expected, more delicate in texture than *E. laevigatum*. *E. funstoni* has a specialized basal branching system and its sheaths are less ampliated than in *E. laevigatum* and *E. kansanum*, having an incurved limb. It is, therefore, in the first stages in this respect of a movement toward a tight, cylindrical sheath as is so prominently developed in *E. praealtum* and *E. hiemale* of the preceding section.

The EQUISETA PUSILLA form a compact group. The lowest species, *E. nelsoni*, has developed the annual habit of the aerial shoot, which is thus the third independent origin of this characteristic. The sheaths are ampliated and have persistent teeth. The internodal ridges are marked by cross bands of silex or a single row of tubercles. In this respect the species stands side by side with *E. laevigatum*. *E. trachyodon* with various related forms is supposed by some to be a hybrid. If it is a true species it is the lowest of the remaining species of EQUISETA PUSILLA. Like *E. variegatum*, the next species in the series, it has double rows of tubercles on the internodal ridges. Here the same character appears as in *E. hiemale* of the second series. From *E. variegatum* there is a decidedly progressive step to *E. scirpoides*, the smallest of the living Equiseta. The double row of tubercles has evolved into a double internodal ridge which looks like two ridges because of the deep central groove. There is but one sheath tooth for the double ridge. A constant number of sheath teeth has been attained, nearly always three on a sheath, and

the central cavity is obliterated. The slender, short, tufted stems are very curly, a bizarre character appearing at the culmination of the series.

The EQUISETA AESTIVALIA show very little if any differentiation between fertile and sterile shoots. Passing from *E. fluviatile* upward there is a progressive reduction through *E. palustre* to the two highest species, *E. bogotense* and *E. diffusum*. In *E. diffusum* the double internodal ridge is again prominently evolved, which makes the third independent origin of this character. The evolution of the peduncle is also progressing, which shows but a slight development in the HIPPOCHAETE series or in the EQUISETA AMBIGUA.

The culmination of the living Equiseta is attained in the HETEROPHYADICA. The two lower species, *E. silvaticum* and *E. pratense* show a decided dimorphism between the sterile and fertile shoots in the scantiness of chlorophyll during the juvenile condition of the fertile shoot and the retarded development of green branches. These two species represent the intermediate stage in the orthogenetic progression from the more primitive condition, as is present in the EQUISETA AESTIVALIA, to the last two species, *E. telmateia* and *E. arvense*, which have an extreme type of dimorphism. This is shown by the complete or nearly complete loss of chlorophyll, the suppression of branch whorls, and the rapid decay of the shoot after the discharge of the spores. In some of the species of EQUISETA HETEROPHYADICA the branches have been reduced to the extreme limit of three internodal ridges and three sheath teeth the same as in *E. scirpoides*. *E. pratense* has three teeth very generally and *E. arvense* has this condition also along with four-toothed sheaths. The branches have also lost the central cavity. In *E. telmateia*, which stands side by

side with *E. arvense*, we meet the double internodal ridge for the fourth time. The two highest species are also remarkable in having the most prominent pedunceles, a normally sterile calyx, and the early completely geophilous development of the flower. There is thus a phylogenetic progression in the time of the determination of the dimorphism. Apparently the shoots in these highest species are definitely determined as vegetative or reproductive at the very beginning of their development. In the lower species with perennial aerial shoots, the differentiation into sterile and fertile determinateness is not brought about until shortly before the final tips are being organized and not until they are actually growing above ground. Frequently shoots that end in determinate vegetative growth will later produce fertile branches near the top. Thus transitions resulting in minute and semisterile cones are much more common in the lower species also. In these characteristics as well as in many other important potentialities, evolutionary orthogenetic series are brought about by the shifting of the point of reproductive determination into earlier and earlier stages of the ontogeny.

COLUMBUS, OHIO

Ferns and Fern Allies of the Muskoka Lake Region of Ontario

CEDRIC L. PORTER and MARJORIE W. PORTER

During the summers of 1928 and 1929 the authors spent their vacations at a camp for boys on Ahmic Lake, one of the Muskoka Lakes. Finding the fern flora there to be interesting, collections were made both years and what is believed to be a fairly complete set of ferns and their allies was obtained.

Ahmic Lake is located on the Magnetawan River about 30 miles from the town of Burk's Falls, and about 35 miles from Parry Sound. The latitude is about 45 degrees thirty minutes, north,—the same as that of the northern part of southern Michigan, the northern tip of New Hampshire, and the middle of Maine. The region is largely coniferous, with hardwoods of the beech-maple type appearing in the higher situations and in cut-over areas. The topography is that of a partially dissected peneplain, with domes of granite rock appearing in low relief. The lakes are fairly deep, and their shores are generally rocky. Occasional swamps and bogs occur in the region, especially along tributary streams and shallow bays of the lake.

Four types of fern habitat are to be found: exposed rocks, hardwoods, swamps and bogs, and dry aspen areas.

ROCKS: The commonest fern on the rocks of the region is *Polypodium vulgare* L. It grows abundantly along the lake shores, but may be found farther inland on exposed rocks in wooded areas. *Cystopteris fragilis* Bernh. is next in numerical importance and occurs in dense tufts on rocks which are almost at lake level along the shores. Although not a rare fern in the region, it is not common. *Woodsia Ilvensis* R. Br. was collected by G. L. Fisher at Bracebridge, in 1898, but was not seen in the region by the authors. A form of *Asplenium filix-foemina* Roth was found on the lake shore growing in crevices of rocks near the water level.

HARDWOODS: In this environment we found several ferns to be quite prominent and these are listed below in the order of their frequency.

Aspidium spinulosum Sw.
Aspidium spinulosum dilatatum (Hoffm.) Hook.
Aspidium marginale Sw.
Phegopteris polypodioides Fée.

Botrychium virginianum (L.) Sw.
Phegopteris dryopteris Fée.
Adiantum pedatum L.

Several Lycopodiums were found here also, and these are listed below in order of their abundance.

Lycopodium clavatum L.
Lycopodium annotinum L.
Lycopodium obscurum dendroideum (Michx.) D. C. Eaton.
Lycopodium lucidulum Michx.
Lycopodium complanatum L.

SWAMPS AND BOGS: This type of environment is common in depressions where lakes have been displaced by the invading vegetation. The trees are chiefly conifers, such as spruce, balsam and cedar. Sphagnum hummocks offer ideal locations for the moisture-loving ferns and here we found the following list of species.

Onoclea sensibilis L.
Osmunda cinnamomea L.
Osmunda Claytoniana L.
Osmunda regalis L.
Aspidium thelypteris (L.) Sw.
Onoclea Struthiopteris Hoffm.

These are arranged in order of their frequency.

The Osmundas are typical bog forms, *O. regalis* being the only one that is found occasionally along the lake shore among the rocks at water level. The Onocleas and *Aspidium thelypteris*, on the other hand, prefer swampy ground and stream banks. An interesting form of the cinnamon fern, *Osmunda cinnamomea*, was encountered in a bog in which there had been some logging done during the early summer. The fertile fronds were partly sterile, some with only a few sterile pinnae and some which had but one or two fertile pinnae at the tip. Willard Clute, in his book on ferns, suggests that this may be

due to injury to the rootstocks which causes the plant to turn partly formed fertile fronds into organs of assimilation. Gray's manual gives it as variety *frondosa* Gray. *Equisetum sylvaticum* is common in swampy places.

ASPENS: This type of habitat yielded but one fern, the common bracken, *Pteris aquilina* L. This is common in the region, but it does not get as abundant there as we have found it in the northern part of Michigan, where it may take complete possession of a considerable area to the exclusion of other plants.

A complete list of the ferns and their allies found is given below.

Adiantum pedatum L.
Aspidium marginale (L.) Sw.
Aspidium spinulosum (O. F. Müller) Sw.
Aspidium spinulosum dilatatum (Hoffm.) Hook.
Aspidium Thelypteris (L.) Sw.
Asplenium Filix-foemina (L.) Bernh.
Botrychium virginianum (L.) Sw.
Cystopteris fragilis (L.) Bernh.
Onoclea sensibilis L.
Onoclea Struthiopteris (L.) Hoffm.
Osmunda cinnamonea L.
Osmunda cinnamonea var. *frondosa* Gray.
Osmunda Claytoniana L.
Osmunda regalis L.
Phegopteris Dryopteris (L.) Fée.
Phegopteris polypodioides Fée.
Polypodium vulgare L.
Pteris aquilina L.
Equisetum sylvaticum L.
Lycopodium annotinum L.
Lycopodium clavatum L.
Lycopodium complanatum L.
Lycopodium lucidulum Michx.
Lycopodium obscurum var. *dendroideum* (Michx.) D. C. Eaton.

DEPARTMENT OF BOTANY, UNIVERSITY OF WYOMING.

A Visit to Sand Mountain, Alabama

E. W. GRAVES

In August, 1929, I had the opportunity of spending a few weeks in Tennessee, visiting with my brother, who lives near Nashville. While so near Sand Mountain, in Alabama, where I had done considerable collecting among the spleenworts and some other rare ferns, I took a few days off to drive back and explore again some of the stations where I had found rarities.

Tennessee has excellent roads, which make automobile travel a pleasure. So one morning we left Nashville on Primary no. 1, which is an asphalt road running east to Knoxville. I intended to take no. 2 at Murfreesboro, but by mistake I kept on no. 1 until I was several miles east of that city. When I discovered I had taken the wrong road I decided not to turn back, but to continue on no. 1 until we reached McMinnville and then turn south and cross Cumberland Mountain, as I was told there was a good road. From McMinnville we drove south 20 miles before we ascended Cumberland Mountain. At the top of the Mountain there is a summer resort, and a large hotel has been erected. We stopped at this place, called Beersheba Springs, and I explored the cliffs below the hotel for ferns. I found *Dryopteris marginalis* quite plentiful on the way up the mountain. On one rocky ledge just below the hotel I noticed *Camptosorus rhizophyllus* and *Asplenium ebeneum* growing, and, as I looked closer, I found a good-sized plant of the hybrid, *Asplenium ebenoides*. I took four of the largest fronds and left the plant growing, as I did not wish to destroy the only station I knew of for that fern in Tennessee.

I decided I had made a good find, and then proceeded over the asphalt road toward Monteagle, at the south

end of the mountain. At another stop I made on the mountain I found *Dennstaedtia punctilobula* and *Dryopteris noveboracensis.* At Monteagle we left the mountain, down an excellent grade into the Tennessee River valley.

My next objective was South Pittsburgh, where I intended to explore the southern station of the hart's-tongue. I found the place without much trouble, although it had been about fifteen years since I had been there. I remember at my last visit I had counted fifty plants, and I wondered how many I would find at this time. I descended to the ledge where the plant had been most plentiful and where conditions seemed best suited to its growth. Imagine my surprise when I could find but three plants. Looking down to the bottom of the sink, I made out three more, but they were down where the sun never shines and the light is poor, and I doubt if those three plants will survive long. They were small plants, too. Of the plants on the ledge above, one was a large plant, with fronds about ten or twelve inches long, and bearing spores. The other two were not so large, but were thrifty plants. Only one plant was accessible to me. The other two were along the narrow ledge where a person would not care to walk without a rope from above to help him hold his footing. Around the walls of the sink were many plants of *Asplenium parvulum* and *Cystopteris bulbifera* growing. These were about the only other ferns growing near the sink hole. As I left the place I decided that in a few years more there would be no hart's-tongue growing at the southern station.

I crossed the Tennessee River and ascended Sand Mountain and went to the home of friends I had known years before.

On the day that some of the members of the Fern Society were exploring the country near Harpers Ferry, I again visited Bucks Pocket, where *Trichomanes Petersii* had been found by me 13 years before. In the spring of 1928 Mr. Benedict and Dr. Wherry of Washington had searched for the place upon my directions and had reported that the little fern had entirely disappeared. That had made me very anxious to revisit Bucks Pocket. Undoubtedly they had missed the exact rock where the fern grew, for I not only found it still there, but it had increased so far as to have established itself nearly all over both sides of the rock, and it was growing six or eight feet higher up the side of the rock than where I had found it on my last visit.

On the next day, which was Labor Day and the party at Harpers Ferry were still exploring locations where some of the rare hybrids grew, I visited the cliffs near Trenton, Georgia, where 14 years before I had found the hybrid which bears my name. I found many plants of *Asplenium pinnatifidum* and a few of *A. Bradleyi*, also two of *A. Gravesii*, one of which was the largest I have ever found. One frond was nearly ten inches long. These plants conformed to the same habit of growth as those I had found before, that is, a very few fronds grew on each plant. I have never found a plant of compact growth, as is the case with *Asplenium Trudelli*.

The next day I visited the station near Long Island, Alabama, where I had found *Asplenium Trudelli* 13 years before. I found a few plants, one of which was a fine large plant. They grew in compact masses, as I had found them on other occasions. There were not many plants, so they do not seem to increase very rapidly. I only found one plant of *Asplenium montanum*, but there were plenty of *A. pinnatifidum*.

Right here I wish to rectify a statement I made concerning the plant Dr. Wherry represented as a hybrid between *Asplenium pinnatifidum* and *A. ebeneum*, and which he had called *Asplenium Stotleri*. Dr. Wherry recently sent me two photographs of the new plant, and, as I looked at them, I at once saw they could not possibly be *Asplenium Gravesii*, as they were of a compact growth with many fronds, besides showing the fronds with narrow pinnae. Perhaps some may remember that in Vol. 16, No. 2, I questioned whether this plant was a new fern or a variety of *Asplenium Gravesii*. Since seeing these photographs I see my mistake. I now believe *Asplenium Stotleri* should be classed as a new fern by the side of *A. Trudelli* and *A. Gravesii*; for it shows quite plainly it is quite different from any other fern.

As I left Sand Mountain it was with regret that I could not spend more time there, but, as I was running on schedule time, I had to hasten on, for my son, who attends college in Nashville, was with me for a few days' vacation. As I drove homeward I felt I had had very good success and had thoroughly enjoyed my trip.

BENTONSPORT, IOWA.

Recent Fern Literature

For those who wish to go deeply into the subject of the classification of ferns, there is much good reading nowadays. It is not very long since the third volume of Prof. Bower's admirably comprehensive and well-balanced "Ferns" appeared. (Cambridge University Press, 1928). Dr. Copeland has published a sketch and rearrangement of the "Oriental Genera of Polypodiceae," making, incidentally, a very readable paper. (Univ. Cal. Pub. Bot. **16**: 45–128. 1929). And Dr. Christensen has completed a detailed study of the curious

group of small genera allied to *Polypodium* but possessing elongate, apparently continuous sori superficially similar to those of *Vittaria*, with full discussion of their affinities. (Dansk Bot. Ark. **6**, no. 2. 1929). All three illustrate the healthy modern trend—not to depend on a single character regarded as fundamental in determining relationships, but to proceed on the theory that everything, no matter how apparently trivial, may be of taxonomic or evolutionary significance, and therefore must be taken into account.

Dr. Christensen is also kept busy determining collections of ferns from various more or less remote parts of the earth. His recent publications include accounts of collections from Borneo (Winkler), New Caledonia (Franc and Däniker), and Madagascar (Humbert), all with critical notes and descriptions of new species and all adding to current knowledge of ferns and their distribution. He has also recorded the finding of *Asplenium germanicum* (*A. septentrionale* × *Trichomanes*) in Denmark and has published a critical review of certain species of Malayan ferns.

In the course of his occasional studies of northeastern ferns, Professor Fernald has detected still another case in which the plant of eastern North America is not identical with the European species to which it has generally been referred. This time it is the marsh fern. The American plant proves to have most of the veins of the fertile pinnules simple—descriptions in current manuals should be amended to read: "veins of the *sterile* segments forked." In addition, it is commonly more or less pubescent and the indusium is glabrous or ciliate with nonglandular hairs. In the European plant, the frond is commonly glabrous, at least half the veins of the fertile segments are forked, and the indusium is coarsely glan-

dular-toothed. None of these characters is wholly constant and the American plant is therefore treated as a variety of the European—*Thelypteris palustris*, var. *pubescens* (Lawson) Fernald. Two other varieties are recognised: var. *Haleana* (new) of Louisiana, Florida and Bermuda, and var. *squamigera* of tropical and southern Africa, India and New Zealand.

In connection with this article, Fernald and Weatherby discuss the generic name *Thelypteris*, arriving at the conclusion that the much more generally used *Dryopteris* can not stand with a clear title unless *Thelypteris* is legislated out of the way by a botanical congress.[1]

Mr. W. A. Anderson, Jr., has produced an excellent and pleasantly written little handbook of the true ferns and grape ferns of Tennessee, attractively illustrated, chiefly from his own drawings. It is based on specimens in the herbarium of the University of Tennessee, and nothing is admitted of which the author has not seen a specimen. This commendably cautious policy has resulted in the exclusion of two species—hart's-tongue and marsh fern—which actually grow in the state, but also, and happily, in the rejection of such wholly improbable records as that of *Asplenium viride* and others less improbable, but still doubtful. On the solid basis thus laid, 43 species are admitted and about each is given pertinent information from the author's own observation and from literature.

In a work intended to aid the inexperienced in naming ferns, the key is of prime importance and naturally attracts criticism. Mr. Anderson has acquitted himself well in this department; a pretty close scrutiny of his key leaves one convinced of its practicability and reveals only one possibly misleading statement and that in a sec-

[1] Fernald, M. L. A study of Thelypteris palustris. Rhodora 31: 27–36, pl. 180. 1929.

ondary character. "Indusium with marginal glands" will hardly do for *Thelypteris spinulosa* var. *americana*. This fern may have such glands, but more often does not; and in any case, they are uncommonly hard to see. A better secondary character between its key-group and that of *T. Goldiana* would have been "Frond tripinnatifid . . . frond at most bipinnate."

A very few minor slips in the technical matter of author citations might be detected by one looking for such things. But altogether the little book is one to be enjoyed and depended upon and should stimulate the pursuit of fern study in its region. It is a pleasure to be able to add that the JOURNAL expects soon to add a rather more extended fern flora of Tennessee by Mr. Anderson to its series of such state floras.[2]

Dr. Ray C. Friesner has undertaken to construct a key to the genera of fernworts of northeastern North America which shall remove the difficulties encountered by the student in using the keys in current manuals. He has a just idea of what a key should be, though there will be some dissent from his dictum that "all members of a set of characters should be kept together, thus making the key more readily followed." Personally, I find the type used in current manuals, when properly indented and numbered or lettered, far the easier for the eye to follow. But given his method, Dr. Friesner has made a brave essay in the difficult art of key-making.

A few suggestions for its improvement may not be amiss. In the first subdivision of heading 4 the word "plants" has apparently been inadvertently employed where "leaves" was intended. And *Schizaea* having been disposed of under this subdivision, it is not ap-

[2] Anderson, W. A., Jr. The ferns of Tennessee. Univ. Tenn. Extension Ser. 6: 1–40. 13 figs. 1929.

parent why it is inserted again under the last subheading of 4, with a key-phrase "Leaves larger, broader, frond-like, common true ferns" which carries little suggestion of the grass-like, almost thread-like plant which *Schizaea* is.

Heading no. 17 would determine *Woodsia glabella*, and, if their indusia were not apparent, *W. obtusa*, *W. scopulina*, and *W. Cathcartiana* as *Cystopteris*. Indeed, it is a good illustration of the difficulties of key-making that, in a key designed to eliminate, among other things, perplexities due to withered or deciduous indusia, Dr. Friesner has been able to find no other practicable means than the characters of the indusium whereby to separate not only *Woodsia* and *Cystopteris*, but *Polystichum*, *Aspidium*, and *Dicksonia* (see headings 29 and following). Something better might have been done in some cases. The frond of *Dicksonia* bears abundant, soft, jointed hairs, the like of which are not to be found in any other genera of this group—at least, not in association with marginal sori. And *Polystichum* and *Aspidium* could be got apart by some further subdivision and double entry, thus:

30. Teeth of margin more or less bristle-tipped. 31.
30. Teeth of margin not bristle-tipped. *Aspidium*.
31. Fronds simply pinnate. *Polystichum* (*acrostichoides*, *Lonchitis*).
31. **Fronds bipinnatifid to tripinnate. 32.**
32. Rachis very chaffy; pinnules conspicuously unequal-sided at base. ***Polystichum*** **(*Braunii*).**
32. Rachis scarcely chaffy; pinnules nearly equal-sided. ***Aspidium*** **(*spinulosum*, etc.).**

But I freely confess that no way of getting *Cystopteris* and *Woodsia* apart except by the nature of their indusia occurs to me; and I expect that so long as the species sur-

vive and men take interest in them, every fern student will, at some time in his career, determine *Cystopteris fragilis* as *Woodsia obtusa* or vice versa.[3]—C. A. W.

THE ASPLENIUM EBENOIDES LOCALITY NEAR HAVANA, ALABAMA.—Having recently hunted up the famous station where this hybrid spleenwort reproduces itself, we are publishing this note to place on record its situation and present condition. A modern highway has recently been constructed between Greensboro and Tuscaloosa, and about 20 miles north of the former passes the tiny settlement of Havana. From the schoolhouse here a dirt road is followed about half a mile to the north, until it crosses a brook, swings northeastward, and reaches a group of negro houses; here another, still poorer road is taken a like distance further northward, down a steep grade to Vernon Branch and up the hill on the other side. On the wooded slope to the east will then be seen a series of rock ledges, and on these the fern is growing.

The following points about the Asplenium seem noteworthy. It is apparently less abundant than in former years, only about 25 adult plants being seen during an hour's search. It is, however, definitely reproducing itself by spores, and a collection was made for the National Herbarium, representing the range from prothallus to adult in four stages, corresponding to as many years. One instance of proliferous frond-tip was observed, and a photograph of the plant showing this, taken May 9, 1929, is reproduced in plate 1.

One of the parent ferns, *Asplenium platyneuron*, occurs sparingly on the same rocks, but no *Camptosorus* could be found in the vicinity. The other rock ferns observed were *Cheilanthes lanosa* and *Polypodium poly-*

[3] Friesner, R. C. Key to genera of ferns and fern allies. Butler Univ. Bot. Studies, no. 5. 1929.

Proliferous Asplenium ebenoides.

podioides. Accompanying plants noted comprised *Aralia spinosa*, *Azalea* sp., *Euonymus americanus*, and *Magnolia macrophylla*, while the forest is made up of beech, hickory, oak, tupelo, etc.

The rock is a brownish conglomerate of siliceous pebbles in a ferruginous and slightly calcareous cement, and the soil reaction at the fern roots proved to be minimacid, similar to that observed for the hybrid spleenwort elsewhere.—EDGAR T. WHERRY and HARRY W. TRUDELL.

Plate 2 represents *Polypodium virginianum cambricoides* F. W. Gray, taken at the type locality, near Peterstown, West Virginia, June 2, 1929. This plant, too, is scarcely holding its own.—E. T. W.

American Fern Society

REPORT OF THE PRESIDENT FOR 1929

By way of supplementing again the reports of the Secretary and the Board of Editors I wish to urge the importance of increasing our membership during the coming year, for which so many good things have been planned by the Editors. Can we not, through the efforts of present members generally, bring the number up to 400? The JOURNAL, well edited and covering an unusually wide field in the study of ferns, should be made available to a far larger circle of readers, from whom additional members would certainly be recruited. Additional members mean more revenue for publication purposes, and with adequate cash in hand there is no telling what our enthusiastic editors may not be able to accomplish in extending and bettering the JOURNAL. Twenty years is a long period of gratuitous service. Ought we not to help by bringing in new members, or at least by contributing cash to the special fund required in carry-

Polypodium virginianum, forma cambricoides.

ing out the 1920 publication program? From its very start the JOURNAL has been a success, winning for itself a secure place in the ranks of botanical literature. Our effort must be to carry it a niche or two higher, not only in professional value but in its wider popular appeal to an increasing number of general readers.

WILLIAM R. MAXON, *President.*

Report of the Secretary for 1929

During the year 1929 the Society has shown a marked increase in new members, twenty-four being recorded with the Secretary to December 31st. We have however lost by death six and by resignation seven; so that the final total, for the year, is not as much larger as would be expected. The net increase is but nine, giving us a total on the lists of 357.

There are also a number of the members who are still carried on the secretary's list who have not paid their dues for two years and to whom in consequence the FERN JOURNAL is not being sent. Some of these names will no doubt be dropped during this coming year.

Respectfully submitted,

CHARLES S. LEWIS,
Secretary.

PLATTSBURGH, N. Y., JAN. 3, 1930.

Report of the Editors for 1929

Just about twenty years ago the American Fern Society recorded itself by vote in favor of the establishment of an official journal to be owned, published, and edited under the direction of the officers of the Society. On August 16, 1910, the first issue of the AMERICAN FERN JOURNAL was printed and distributed, a 16-page number, with 5 articles, including one illustration of a matricary

botrychium, showing two leaves arising from one root. The first two numbers of the FERN JOURNAL were printed and published by private subscription as an experimental demonstration. With the beginning of 1911, however, the officers of the Society adopted the new magazine as their official organ.

Now, at the beginning of 1930, with this issue, Volume 20 is under way. It has seemed fitting to the Editors to signalize this anniversary year by an increased size, to include a considerable number of articles representing the far-flung membership and affiliations of the Society at present. In accord with this plan, contributions of articles have been solicited from our members and friends all over the world, together with special articles from American members.

The Editors are ambitious. From one has come the suggestion of an increased size of page, from another a proposal for 4 numbers of 100 pages each, and the other Editor, more conservatively, is preparing to take care of what actually is received. The officers are sympathetic to the idea of an anniversary expansion. It will be obvious that an increase in size of the JOURNAL will require greater expenditures and increased activity in the way of articles. We invite reminiscences, we invite contributions, both of copy and of cash, not to speak of advice.

As a matter of interest, it may be noted that one of the contributors to that first volume, Dr. Carl Christensen, has also prepared an article for the 20th volume.

In addition to these plans for the future, the Editors wish again to call attention to a matter relating to the past: viz., the stock of back numbers. From the Secretary's report, and from indications so far this year, it would seem that the Fern Society is definitely growing in a very healthy way. Increasing membership means increasing demand for back numbers, complete sets.

As a result, the stock of back numbers has been so reduced that we shall have to plan to reprint two early numbers very shortly, and probably several others within two years. This policy, of making it possible to obtain complete sets by reprinting early numbers, differs from that of many periodicals but we believe it is for the best interests of the Society and for our increasing numbers of new members.

We would again ask older members to look through their files to see whether they may have surplus numbers of early issues. Our files have benefitted during the past year from the gifts of several members who found copies, even of the rarest number, Volume 1, Number 3, which had previously been reprinted some time ago. Look over the tabulation below and see whether you cannot find a surplus of the listed rarities of the first four volumes. Of the other early numbers, we have at least fifty of every issue but any surplus copies will be gladly received.

Volume	1:	No. 1	11 copies	
"	1:	" 3	7 copies	(Since reprinting)
"	1:	" 4	16 copies	
"	3:	" 2	11 copies	
"	3:	" 3	21 copies	
"	3:	" 4	19 copies	
"	4:	" 1	25 copies	

It may be added, as a matter of record, that in 1929 the JOURNAL printed 146 pages and twelve illustrations.

R. C. BENEDICT,
E. J. WINSLOW,
C. A. WEATHERBY, *Editors.*

Report of the Judge of Elections for 1929

As Judge of Elections of American Fern Society I hereby submit my report of the election of officers of the Society for the year 1930:

I received a total number of 99 ballots, of which two were from foreign countries. The persons hereinafter named received the number of votes stated after their names respectively:

For *President:* William R. Maxon, 97 votes.

For *Vice-President:* Mrs. Carlotta C. Hall, 96 votes; Ellsworth P. Killip, 1 vote.

For *Secretary:* Charles S. Lewis, 96 votes.

For *Treasurer:* J. G. Underwood, 97 votes.

Blank Ballots: 2 ballots were entirely blank and 1 ballot blank for Secretary.

I accordingly report that the present officers were duly re-elected for the year 1930.

Respectfully submitted,
FREDERICK WM. KOBBÉ.

December 16, 1929.

I hereby attest that the above is a correct copy of the report of the Judge of Elections.

CHARLES S. LEWIS, *Secretary.*

January 3, 1930.

DOES YOUR LOCAL LIBRARY HAVE THE FERN JOURNAL IN ITS FILES?—The FERN JOURNAL has about 100 subscribers, as distinguished from the 357 Society members, mostly educational institutions, colleges, museums, etc., but with a fair number of local city public libraries. It is probable that there are numerous other libraries which would be interested to subscribe if the matter were brought to their attention. The Editors suggest that our members take occasion to inquire in their own localities.

Visit the libraries and show them your copies of the JOURNAL. If the library funds do not allow subscription for a periodical of so specific a field as the FERN JOURNAL, there is no objection to contributing an extra subscription with the idea of putting the JOURNAL into the library files. A year's trial may convince the librarian that there is a real call for a fern periodical.

HAS YOUR LOCAL NEWSPAPER EVER HEARD OF THE FERN JOURNAL?—If not, we suggest that you call on the editor, show him a copy, and write a brief letter for publication in the newspaper. Such a letter might very well mention the long history of the Society, the present twentieth anniversary volume of increased size, the total number of pages so far published—over 2,400 a year ago, it will be nearly 3,000 by January, 1931—the wide range of membership, the articles on cultivated ferns, on ferns as the hobby of geologists, mechanical engineers, not merely of professional botanists, etc. In your letter, you might mention that you will be glad to arrange to have a sample FERN JOURNAL sent to any interested reader of the paper; such requests will be honored if forwarded to R. C. Benedict at the Brooklyn Botanic Garden.

This note is prompted by the frequent comment in letters about new members to the effect that so-and-so had been interested in ferns for years and had never heard of the Fern Society or JOURNAL.

New members:—

Churchill, Mrs. Mabel W. (Mrs. George B.), Amherst, Mass.
Ewan, Joseph, 1631 Shatto St., Los Angeles, Cal.
Frazee, Vernon L., 67 E. Fourth St., Clifton, N. J.
Griffin, Miss Margaret, 324 Broadway, Apt. 506, Patterson, N. J.
Haring, H. A., Woodland, Ulster Co., N. Y.
Haring, Mrs. Inez M., Woodland, Ulster Co., N. Y.
Howard, Dr. Grace E., Dept. Botany, Wellesley College, Wellesley, Mass.

Keffer, Dr. Edward I., 5971 Drexel Boulevard, Philadelphia, Pa.
Oliphant, Roy L., 98 Glen Ave., Oakland, Cal.
Ottley, Prof. Alice M., Dept. of Botany, Wellesley College, Wellesley, Mass.
Stewart, F. E., 1708 Gardena Ave., Long Beach, Cal.
Whitney, Mrs. Elsie Gibson, (Mrs. Alvin), State Museum, Albany, N. Y.

Changes of address:—

Choate, Miss A. D., Usona Hotel, 2002 Waterman Ave., St. Louis, Mo.
Kirkham, Prof. W. B., 275 Maple St., Springfield, Mass.
Richardson, H. H., 25 Cottage St., Brookline, Mass.
Sawyer, Mrs. N. T., 1143 Hinman Ave., Evanston, Ill.

The printer's devil (everyone who has anything to do with the craft knows that such an imp exists) must have been present when page 136 in Volume 19, no. 4 of the JOURNAL was finally corrected and struck off. He managed to carry off the parentheses which should have enclosed the word "Gilbert" in the first line of the footnote and thereby ascribed to that gentleman a combination which he never made. The line should have read "*Dryopteris spinulosa* (O. F. Muell.) Ktze., var. **fructuosa** (Gilbert), n. comb.," or, to make the citation complete, "var. **fructuosa** (Gilbert) Trudell, n. comb."

Dr. M. R. Sharpe, Uxbridge, Mass., would like to exchange living plants of climbing fern, *Lygodium palmatum*, and of mandrake, for living plants of any hardy fern not now in his garden. He already has *Onoclea sensibilis* and *Struthiopteris*; all three Osmundas; *Botrychium virginianum*; *Aspidium cristatum*, *marginale*, *noveboracense*, *spinulosum*, var. *intermedium*, and *Thelypteris*; *Polypodium*, *Adiantum*, *Dicksonia*, *Asplenium Filix-femina*, *acrostichoides*, *platyneuron*, and *Trichomanes*; all *Phegopteris* except *P. Robertiana*; both Cys-

topterises; and *Woodwardia areolata*. Anything not on this list will be welcome.

A complete collection of hardy American ferns will be maintained at this test garden. The local and rare species cannot, of course, be obtained from dealers, nor easily collected. The assistance of members of the American Fern Society is asked, that through correspondence, exchange, purchase, or gift, the less common species of the northeastern states, the southern Appalachians, the Ozarks, and the Pacific Northwest may be procured either as plants or as spores.—Stephen F. Hamblin, Lexington Gardens, Inc., 93 Hancock St., Lexington, Mass. —*Adv.*

Fronds of the species listed below, collected and generously furnished for the purpose by Mr. H. E. Ransier, will be distributed to members on application to C. A. Weatherby, 27 Raymond St., Cambridge, Mass., and payment of postage. The supply is limited, but will be made to go as far as possible. *Cheilanthes Eatoni, C. Covillei, Notholaena Hookeri, N. bonariensis, Gymnopteris hispida, Pellaea mucronata.*

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American Fern Journal

A QUARTERLY DEVOTED TO FERNS

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EDITORS

R. C. BENEDICT

E. J. WINSLOW C. A. WEATHERBY

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The genus Cyrtomium

Carl Christensen

Dr. Benedict was so kind as to ask me to contribute an article to the twentieth volume of the Journal and it was a pleasure to me to do it, though I was in doubt as to the matter which I should choose for the anniversary volume. At about the same time Dr. Maxon asked me, however, to revise the specimens of *Cyrtomium* contained in the U. S. National Herbarium, and on the basis of that material and a considerable number of specimens from other herbaria, especially from the University of California, which were kindly sent to me by Dean Merrill, I have worked out a preliminary review of the species belonging to that genus, which is herewith published.

The subject chosen is perhaps a bad one for an article in this journal, because the genus *Cyrtomium* is not an American but essentially an Asiatic genus, but on the other hand some of the species are very commonly cultivated and certainly known to most readers of the Journal. One species (*C. falcatum*) is one of most important commercial ferns, which thrives well in dwelling rooms and, in the southern States, is no doubt hardy in the open air and to be found here and there as an escape from gardens. Another species (*C. caryotideum*) occurs in the Hawaiian Islands, belonging to the United States;

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thus it is seen that the genus is not without interest for American fern-lovers.

The genus *Cyrtomium* was based by Presl (1836) upon the Japanese fern since best known as *Aspidium falcatum*, later on by Diels and my Index Filicum referred to *Polystichum*, from which I again in the supplement to the Index (1913) segregated it and restored *Cyrtomium* as a genus. It must be granted that the technical difference between *Cyrtomium* and some species of *Polystichum* seems to be rather unimportant, being found chiefly in the venation, and that character is, moreover, not quite constant as a generic one. The species referred below to *Cyrtomium* form, however, a distinct group, which besides by a distinctive venation is characterized also by a number of indescribable characters which justify the treatment of the group as a genus. The boundary between *Cyrtomium* and *Polystichum* is, however, difficult to define, and while I have chosen to use the venation as the prime discriminating character, it must be remembered that some species still retained in *Polystichum* show a tendency to anastomosis of the veins. However, these species are otherwise so different from the true *Cyrtomia* that it seems unnatural to place them in the same genus.

In the present article I limit *Cyrtomium* to include such species only as normally have anastomosing veins, which form one to several rows of areoles each containing 1–3 free included fertile veinlets; the venation is practically the same as in the subgenus Goniophlebium of Polypodium. The leaf is never proliferous by buds on the rachis or by a rooting apex, by which character the genus differs from some apparently related species of *Polystichum* (*P. lepidocaulon*, *P. basipinnatum*).

As here construed the genus does not include two species hitherto referred to it, viz., *C. fraxinellum* Christ and

C. Boydiæ (Eat.) Robinson. The former is a Chinese species, the relationship of which is uncertain; the veins are sometimes partly united near the margin but they do not form regular areoles with free included veins and this species should probably be placed in the section *Pycnopteris* of *Dryopteris*. The venation of *C. Boydiæ* from the Hawaiian Islands is goniopteroid, not goniophlebioid and its whole habit is different from all species of *Cyrtomium*. I am uncertain about its systematical position. Concluding these few remarks I shall finally point out that the Asiatic genus *Cyrtomium* and the American one, *Phanerophlebia*, have many important characters in common, including several by which both genera differ from *Polystichum*. I regard them both, nevertheless, as distinct genera derived from different polystichoid ancestors.

The following review of the known species of *Cyrtomium* is a preliminary one, where only the most important characters of the species are briefly mentioned. Full synonymy, descriptions and quotations of the specimens examined I prefer to leave to a more comprehensive treatise on the genus.

KEY TO THE SPECIES

1. Apex of leaf pinnatifid, texture mostly thin; veins sometimes partly free, normally goniophlebioid with 1–2 rows of areoles, each with a single, fertile vein, sori therefore in 1–2 regular rows 2

   End pinna distinct, usualy trilobed, texture papyraceous to thickly coriaceous; venation more complicated, as a rule with more rows of areoles including 1–3 free veinlets which sometimes are variously anastomosing; sori of larger leaves in several rows 4

2. Pinnæ lanceolate or linear, not falcate, exauriculate or with an obtuse auricle 3

   Pinnæ trapezoidal, decidedly falcate and strongly auriculate
   3. *C. vittatum*.

3. Pinnæ broadest at base, often with an obtuse auricle above, mostly serrate throughout, generally with one row of costal areoles; stipe and rachis slightly paleaceous. Central Asia
1. *C. Hookerianum.*

Pinnæ linear-lanceolate, without auricle and quite entire in the lower two-thirds; areoles and sori biserial; stipe, rachis and underside rather scaly ——— 2. *C. Tachiroanum.*

4. Leaf thickly coriaceous, the very margin thick and quite entire ——— 5

Leaf thinner, the margins more or less toothed, invariably so towards the apex of the pinnæ ——— 7

5. Frond simple, cordate or palmately lobed, ivy-shaped
4. *C. hemionitis.*

Frond pinnate ——— 6

6. Pinnæ cordate at base, the apex rounded or shortly acute
5. *C. nephrolepioides.*

Pinnæ large, falcate, acuminate or cuneate at the lower, rounded-truncate at the upper base, shining above
6. *C. falcatum.*

(See also *C. caryotideum* var. *intermedium*)

7. Pinnæ in 10–25 pairs, rather small (rarely exceeding 6 x 2 cm.), end pinna smaller, dull green; margins finely crenately toothed throughout or toward the apex only; stipe of young fronds densely scaly with large scales, the rachis fibrillose with broader linear scales mixed with woolly, hairlike ones 8

Pinnæ in 3–6 pairs, large (6–10 × 3–5 cm.), mostly strongly auriculate or biauriculate, toothed throughout, the teeth aristate; end-pinna as large or larger; stipe chaffy chiefly at base, the rachis slightly fibrillose ——— 9. *C. caryotideum.*

8. Pinnæ very numerous and small, rarely exceeding 3 x 1 cm., strongly auriculate, the auricle triangular acuminate minutely and obtusely dentate throughout ——— 8. *C. lonchitoides.*

Pinnæ larger, normally exauriculate or obtusely auricled 9

9. Pinnæ obtusely toothed throughout, generally 5–8 cm. long by 2–2.5 cm. wide, obtusely auricled
9. *C. caryotideum* var. *micropteris.*

Pinnæ usually toothed near the very apex only, rarely subauriculate, dull green ——— 7. *C. Fortunei.*

1. **Cyrtomium Hookerianum** (Presl) C. Chr. comb. nov.

Lastrea Hookeriana Presl, Tent. Pterid. 77. 1836. name only.

Polystichum Hookerianum C. Chr. Ind. 582. 1906.
Aspidium caducum Wall., Hook. et Grev. Ic. Fil. pl. 171. 1829 (not H. B. K. 1815).
Type from Eastern Himalaya: Nepal, leg. Wallich.
Distribution: Eastern Himalaya and S. W. China (Yunnan).

Excellently illustrated by Hooker and Greville at least as to habit and size; the venation is perhaps inaccurately figured with all veins free, still I have seen some few specimens with nearly all veins free. Usually they anastomose and form a row of oblique goniophlebioid areoles at each side of the costa. Because of this character I place the species under Cyrtomium, though it together with the two following species as to important characters deviates from the other species of the genus; the lamina tapers gradually upwards into a pinnatifid apex without distinct end-pinna, the venation is simpler and the serrature different, the margins are not finely toothed as in *C. caryotideum*, but more coarsely serrate (sometimes subentire), the teeth usually sharp.

With this species another Himalaya and Chinese fern has hitherto been confused; it is excellently figured as *Cyrtomium caducum* Beddome (Ferns Brit. Ind. pl. 45 and originally named *Polypodium polyodon* by Wallich but never described under that name); it seems to be identical with the Chinese *Dryopteris pycnopterioides* Christ, and in my opinion it does not belong to *Cyrtomium* and even not to *Polystichum*, rather to a specialized group of *Eudryopteris*, very rich in forms in Central Asia. This species will be discussed further in another paper.

2. **Cyrtomium Tachiroanum** (Luerss.) C. Chr. comb. nov.

Polypodium (?) *Tachiroanum* Luerssen, Engler's Bot. Jahrb. *4*: 362. 1883; C. Chr. Ind. 569.
Polystichum integripinnum Hayata, Icon. Fl. Formosa *4*: 196, fig. 133. 1914.

Cyrtomium integripinnum Copeland, Philipp. Journ. Sci. *36*: 136. 1929.

Type from Japan: Satsuma, leg. Tachiro (Herb. Berlin.)

Distribution: Southern Japan and Formosa.

Very closely related to *C. Hookerianum*, differing from it by its longer frond, narrower linear-lanceolate pinnæ (8–10 cm. x 1–1.5 cm.), subequally cuneate at base with the upper side more rounded, not auriculate. Indusia not seen, probably fallen or abraded in the specimens examined. Very strangely Luerssen referred this species to *Polypodium* subgenus *Goniophlebium*.

3. CYRTOMIUM VITTATUM Christ, Bull. Soc. Bot. France *52 Mém.* I: 33. 1905.

Polystichum vittatum C. Chr. Ind. 588. 1906.

Polystichum Balansae Christ, Acta Hort. Petrop. *28*: 192. 1908.

Cyrtomium Balansae C. Chr. Ind. Suppl. 23. 1913.

Polystichum miyajimense Kodama in Matsumura: 1 conn. Pl. koish. 11. No 3, 51 pl. 110. 1910 (quoted from Nakai).

Type from Yunnan, leg. Delavay (Herb. Paris).

Distribution: Southern China from Yunnan to Fukien and Kwangtung, Tonkin, Japan: islands of Miyajima and Quelpart.

This species agrees in most important characters with the two former, but in general habit it more resembles some forms of *C. Fortunei;* easily distinguished from that species by the upper pinnæ gradually diminishing and running into the lobed apex, the pinnæ strongly falcate and auriculate, the margins uneven, repand, sharply serrate in the outer half, the largest 7–8 cm. x 1–5 cm.

4. CYRTOMIUM HEMIONITIS Christ, Bull. Acad. Géogr. Bot. Mans. *1910*: 138, with fig.

Type from China: Kweichou, leg. Cavalerie No. 3377.

Distribution: known from a couple of localities in the said province only.

Apparently a very distinct species and very different from all others by the simple 3–5 lobed ivy-shaped leaves of very thick texture, but in all other characters it agrees so closely with the following species that I am nearly convinced that it really is a form of that species with simple leaves.

5. CYRTOMIUM NEPHROLEPIOIDES (Christ) Copeland, Philipp. Journ. Sci. *38*: 136. 1929.

Cyrtomium grossum Christ. *ibid. 1906*: 239.

Polystichum nephrolepioides Christ, Bull. Acad. Géogr. Bot. Mans. *1902*: 258 with fig.

Polystichum pachyphyllum Rosenstock, in Fedde: Repert. Sp. Nov. *13*: 130. 1914.

Cyrtomium pachyphyllum C. Chr. Index Suppl. prél. 1913–16: 11. 1917.

Type from China: Kweichou, leg. Laborde et Bodinier No. 2526 (Herb. Paris.)

Distribution: Only known from some few collections in the said province.

To this species I refer a series of forms which vary greatly in size, but as to all other characters are very uniform, so I have no doubt that the synonymy given above is correct. The original type is apparently a high-alpine dwarf form with numerous small pinnæ (10 x 5–7 mm.), but in the later collections of Cavalerie this small form is often found together with some much larger, which again run gradually into the largest form described as *C. grossum* (of which *C. pachyphyllum* is a direct synonym, I think); here the number of pinnæ are reduced to 2–4 pairs and the largest 6 x 3 cm., the large trilobed end-pinna very much resembling the whole blade of *C. hemionitis*, which, therefore, properly may be considered as the most reduced form concerning the number of pinnæ. From the related *C. falcatum* all forms differ by the cordate, obtuse pinnæ.

6. CYRTOMIUM FALCATUM (L. fil.) Presl. Tent. Pterid. 86. 1836.

Polypodium falcatum L. fil. Suppl. Spec. pl. 446. 1781; Thunberg, Fl. Japan. 336, pl. 35.

Polystichum falcatum Diels; C. Chr. Ind. 581 (excl. syn.)

Type from Japan, leg. Thunberg.

Distribution: Southern Japan, Korea, Formosa, Eastern China (Shantung to Chekiang); the distribution in continental Asia is still not finally delimited; nearly all specimens from China called falcatum do not belong here; I have seen no specimen from the central and southern provinces. It is sometimes found as an escape from gardens in warmer countries, for inst., *Alabama:* Mobile (E. W. Graves No. 1253); *Florida:* St. Augustine (P. O. Schellert 1923); *Molokai,* Hawaiian Islands (Degener and Wiebke No. 3217, U. S. Nat. Herb.)

The genuine *C. falcatum* is a very distinct species, not easily confounded with others when seen in a living state, but when dried rather difficult to distinguish from the larger forms of *C. Fortunei*, which, therefore, by most writers has been considered a form of it. The living plant is especially well-marked by the shining upper side of the frond and the thick, coriaceous texture, widely different from the dull green fronds of *C. Fortunei* and the thinner texture of *C. caryotideum*. Dried specimens may be distinguished by the thick texture and especially by the quite entire margins; the pinnæ are as a rule more or less repand or slightly lobate, but the thickened margins are quite intact from the base to the very tip; veins thick and prominent beneath. The indusia are large, persistent, first whitish, soon brownish and finally blackish in the centre with paler edges.

As to the characters mentioned *C. falcatum* is fairly constant; it varies in size and number of pinnæ (these sometimes 4–5 cm. wide, usually not auricled, the end-pinna small) and especially in the marginal cutting. The most extreme form is:

Forma ACUTIDENS (Christ) Nakai, Bot. Mag. Tokyo *39*: 114. 1925.

Cyrtomium acutidens Christ, Bot. Mag. Tokyo *24*: 24, 1910.

Cyrtomium (or *Polystichum*) *Rochefordii* hort.

A well-known cultivated form with lobed pinnæ, the lobes unequal, triangular, acuminate, up to 2 cm. long, the basal upper one usually much larger, like the auricle of *C. caryotideum*. In size and by large end-pinna this form approaches that species, but the glossy upper side and quite intact margins prove that it is a form (mutant?) of *C. falcatum* (or possibly a hybrid between *C. falcatum* and *C. caryotideum?*).

C. falcatum with *f. acutidens* is one of the most important ferns in commerce; it is not quite hardy in the open air in Northern Europe, but an excellent pot-plant for rooms.

7. CYRTOMIUM FORTUNEI J. Smith, Ferns Brit. and Foreign 266. 1866.

Polystichum Fortunei Nakai, Bot. Mag. Tokyo *39*: 116. 1925.

Polystichum falcatum var. *polypterum* Diels, Engler's Bot. Jahrb. *29*: 195. 1900 (ex parte), and var. *acuminatum* Diels l. c.

Type: Described from cultivated plants which are said to have originated from Japan. I suppose, however, that it was brought home by Robert Fortune from southeast China, where it is very common.

Distribution: Southern Japan to southeast China and Tonkin, westwards to Shen-si and Szechuan. In Yunnan it seems to blend with the smaller forms of *C. caryotideum*.

This species is in a living state easily distinguished from *C. falcatum* by the dull green, not glossy, upper side of the fronds, the more numerous and smaller, lanceolate or oblong pinnæ, which are 5–8 x 1–2.5 cm., acuminate, as a rule not auricled; the best characters of dried

specimens are to be found in the margins which are rarely quite entire but as a rule minutely dentate, and the acuminate tip is invariably dentate by some few sharp teeth. The leaf is less coriaceous and the veins not raised beneath as in *C. falcatum* the indusia unicolorous, pale, not brown or blackish in the centre.

C. Fortunei is, as here construed, a variable species with regard to size, number and shape of pinnæ. A common continental form of it with smaller pinnæ is often named *Pol. falcatum* var. *polypterum* Diels; it runs gradually into the following species, and forms with auricled pinnæ are not rare.

8. CYRTOMIUM LONCHITOIDES Christ, Bull. Acad. Géogr. Bot. Mans *1902*: 264.

Aspidium lonchitoides Christ, Bull. L'Herb. Boiss. *7*: 16. 1899.

Polystichum lonchitoides Diels, C. Chr. Ind. 581.

Polystichum falcatum var. *polypterum* Diels, Engler's Bot. Jahrb. *29*: 195. 1900 (ex parte).

Type from China: Yunnan, leg. Henry No. 11829.

Distribution: Central and Southeast China, Hupeh, Kweichou, Sze'chuan, Yunnan.

Very near the smaller forms of *C. Fortunei* and probably only a form of it. It differs mainly by the short stipe, and by the large number (up to 25 pairs) of small pinnæ, which are 2–2.5 cm. x 1 cm. only, triangular in shape, short-acuminate, distinctly auricled, the lower ones usually somewhat shortened and reflexed, the upper ones gradually diminishing; margins finely crenately toothed throughout, the teeth obtuse, those of the acuminate apex sharper. Underside with rather many hair-like reddish fibrils.

9. CYRTOMIUM CARYOTIDEUM (Wall.) Presl, Tent. Pterid. 86, pl. 2, fig. 26. 1836.

Aspidium caryotideum Wallich: Hook. and Grev. Ic. Fil. pl. 69. 1828.

Aspidium anomophyllum Zenker: Pl. Ind. pl. 1. 1834.

Polystichum falcatum var. *macropterum* Diels, Engler's Bot. Jahrb. *29*: 194. 1900.

Type from Himalaya: Nepal, leg. Wallich!

Distribution of the typical form: From Himalaya through southwest China (Yunnan and Sze'chuan) to southern Shen-si, Formosa (Japan, t. Nakai), Tonkin. South India (Nilgiri, *A. anomophyllum* Zenker); Hawaiian Islands, found in all islands.

Extremely variable in size but fairly constant in its chief characters by which it differs from *C. falcatum* with which it has often been united. The number of pinnæ is always small, 3–6 to each side, and a terminal one that as a rule is the largest and deeply trilobed with acuminate or caudate lobes; lateral pinnæ mostly 10–15 x 3–5 cm., often contracted into a long caudate apex and with a large acute auricle at the upper base, sometimes biauriculate (var. *hastosum* Christ, Bull. Soc. bot. France *52* Mém I: 32); margins from base to tip finely but irregularly dentate, the teeth aristate. Texture rather thin, color dull green.

With this Himalayan type agree closely the South Indian form described and illustrated as *Asp. anomophyllum* Zenker, and further the Hawaiian specimens, which differ only by the practically naked leaves; a majority of them belong to *f. hastosa* Christ. More or less different from the type are the following forms:

Var. **aequibasis,** n. var. Pinnæ narrower (14 x 2.5 cm.) equally cuneate at base, without auricle, gradually acuminate. Approaches *C. Fortunei*, differing from it by the aristate teeth and large end-pinna.

YUNNAN: Mengtze (W. Hancock No. 8, U. S. Nat. Herbarium No. 1277428, type).

ASSAM: Khasi Hills (G. Mann).

Var. **intermedium** (Diels) C. Chr., **comb. nov.**

Polystichum falcatum var. *intermedium* Diels, Engler's Bot. Jahrb. *29*: 195. 1900.

Cyrtomium falcatum var. *muticum* Christ in Lecomte, Not. syst. *1*: 37. 1909.

Differs from the type, which it resembles in size and texture, by the equal-sided pinnæ with entire margins, at best with one or two obsolete teeth near the very apex.

CHINA: Sze'chuan (Rosthorn, type), Yunnan, Hupeh, Anwhei; N. W.

HIMALAYA: Simla.

Var. **micropteris** (Kunze) C. Chr., comb. nov.

Aspidium anomophyllum var. *micropteris* Kunze, Linnaea *24*: 278. 1851.

Polystichum falcatum Sim, Ferns of South Africa, pl. 32.

Pinnæ in 6–10 pairs below the not much larger, trilobed end-pinna, generally much shorter than in the type (5–8 x 2–2.5 cm.) shortly acuminate, finely toothed throughout, the teeth not aristate, and usually with a short, obtuse auricle.

South India, Nilgiri. Madagascar. South and East Africa from Cape and Natal to Transvaal and Griqualand, tropical East Africa; Mt. Kilimandjaro. Very similar forms occur in South-west China; they are, I believe. small caryotideum.

COPENHAGEN.

The Ferns of Central Chile

GUALTERIO LOOSER

The members of the American Fern Society who study with such ardor and profit the pteridological flora of North America, will I trust have a certain interest in receiving some data concerning the ferns of Chile, in the opposite extreme of the western hemisphere.

Chile is a narrow strip of land separated from the Argentine Republic by the high mountain range of the Andes. Its length is enormous compared with its width. The extreme north of Chile is at the 18th degree south latitude, while its opposite end is at 56 degrees south

latitude, reaching to the antarctic seas, and thus giving it a total length of 4,200 kilometers. Conditions so diverse that their equal is to be found in but few parts of the world, naturally reflect themselves in the country's flora and especially in the ferns. All the north of Chile is a desert or semi-desert and there we find hardly any ferns. Only a few specimens and species exist in certain very favored sections. The southern half of the country, on the other hand, which has a very rainy and humid climate, is covered by woods and forests and there the ferns have a very great growth, manifested especially in the genera *Blechnum*, *Hymenophyllum* and *Gleichenia*. The 160 species of Chilean ferns, more or less, are nearly all found in the south. This is a sufficiently considerable number, especially if the high degree of latitude be taken into account. In the same latitude I believe that only New Zealand and Japan surpass Chile in its fern vegetation. The wealth of Chilean ferns is more striking if we compare it with the United States which has a surface more than ten times as large as that of Chile. Yet the total number of its ferns is but little superior to that of Chile.

But the central region of Chile which is the part that I know well and to which this communication refers, is far from being as exuberant as the South and constitutes in reality a zone of transition between the deserts of the North and woodlands of the South.

I shall here concern myself only with the part of Chile limited on the North by the basin of the Aconcagua River and on the South by the River Maipo. Toward the West is the Pacific Ocean and on the East the High Andes, which have in this region the highest peaks in all America, with Mount Aconcagua 7,000 meters in height, and many other giants of very little less altitude. This zone is the most thickly populated of Chile and con-

tains its capital, Santiago, and Valparaiso, its principal port.

The climate is dry but temperate and agreeable. It rains exclusively in the winter (May to October); but the precipitation does not exceed an average of 500 mm. a year. In the Andes, however, immense quantities of snow fall which are the water reserves for the summer.

The vegetation is frankly xerophytic. The plateaux, the wide valleys, the plains and the hills have trees and bushes adapted to a dry climate (*Acacia cavenia*, *Peumus boldus*, *Quillaja saponaria*, some *Cactaceae* and *Bromeliaceae*, tall and very decorative). Many beautiful herbs come forth in the Spring only to dry up very rapidly. Only in the most narrow gullies of the hills are there woods and tall dense vegetation.

In these woods and dense thickets numerous ferns grow, but belong to only a few species. The most abundant are surely the *Adiantums*: *A. chilense* Klf. var. *hirsutum* Hook. (*A. glanduliferum* Link non Remy), *A. scabrum* Klf., *A. sulphureum* Klf. and *A. excisum* Kze. The last three are very beautiful. The lower part of the pinnulae of *A. scabrum* are sown with little white grains, while in *A. sulphureum* a sulphur colored powder covers without interruption the reverse side of the pinnulae. *A. excisum* has small and very transparent pinnulae. There has also been seen in this region the real *Adiantum chilense*, which is distinguished by having pinnulae that are completely glabrous. I also have encountered in this zone glabrous examples, but there is always a doubt in my mind whether it is the real *A. chilense*. I think that in many cases they are not more than *A. sulphureum* or *scabrum* that have lost the powder that adorns the pinnulae. The *Adiantum chilense typicum* is common in the rainy region of the South of Chile and on the Islands of Juan Fernandez; but it has an aspect

that is not entirely identical with the glabrous form of the central part of the country that I have seen. Therefore, I am obliged to observe a vacillating attitude regarding the *Adiantum chilense typicum* of central Chile.

There is also to be mentioned *Adiantum Pearcei* described by Dr. R. A. Philippi, the great naturalist of Chile, and which was found at Chacabuco a little to the North of Santiago, but it seems that no one has ever found it again.

With less frequency one may see the *Adiantum* growing along the roads or in places somewhat sunny. Mixed with the *Adiantum* appears with considerable frequency the world-wide *Cystopteris fragilis*, but on the other hand I believe that the other cosmopolitan fern *Pteridium aquilinum* has never been found in Chile, but that it is found in Argentine and in the South of Peru. The desert of Atacama in the North of Chile and the Andes have probably impeded its arrival, as they have succeeded in doing with so many other animal and vegetable species. To these great geographical peculiarities Chile owes its very independent flora and fauna with numerous endemics. That they have much greater need of water is demonstrated to be the case with *Blechnum auriculatum* Cav. common along the streamlets, and *Blechnum chilense* Mett., which is larger but rather scarce in this zone. I know only 4 or 5 localities in swampy ground near the coast of Valparaiso and Santiago. On the other hand, it abounds in the South of the country. Similar conditions of humidity are required by *Dryopteris argentina* C. Chr. (*Aspidium rivulorum* auct. chil.), whose beautiful leaves of a dark green color frequently reach a length of 1.70 meter; and *Dennstaedtia lambertiana* Christ which is the most beautiful fern of Central Chile. It has a long creeping rhizome which generally lives in the water of mountain ravines. Every

few inches leaves grow out 1.50 and 1.80 meter in height that are very divided and sometimes form rather extensive agglomerations of a very light color. The two last named species are not abundant.

The soils with xerophytic vegetation predominate in a very marked form in Central Chile, as I have already given to understand above, and there one sees only a few ferns adapted to such conditions and belonging to the typical xerophytic genera. They are *Cheilanthes glauca* Mett. (*Ch. chilensis* Fée), *Notholaena hypoleuca* Kze. and *N. mollis* Kze. They abound somewhat among the smooth rocks of the hills which look towards the North, that is to say, in the southern hemisphere, towards the sun. *Notholaena mollis* is very curious, since it is covered with starlike hair which is easily seen with low powered microscopes. *Pleurosorus papaverifolius* Fée is more scarce and also lives among rocks. This little fern belongs to a very curious genus of *Polypodiaceae* with only three species, one in Spain, one in New Zealand and Australia, and the third in Chile. It is difficult to imagine more discontinuous areas. In the few swamps, slow courses of water, canals, etc., is frequently seen *Azolla filiculoides* Lam., which varies greatly in form, depending upon whether it lives floating on water or on humid earth. In damp and swampy places there are to be seen two *Equisetums: E. bogotense* H. B. K., a small plant, and *E. pyramidale* (?) Goldm., (*E. giganteum* auct. chil.). This latter reaches a height of from 4–6 meters. Sometimes it invades completely the vegetation of the rivers, artificial woods, etc.

The former species are the most common of Central Chile and are lacking in hardly any collection, but there are various ferns much more scarce and that are only found by chance. For example, I have only one specimen of *Cheilanthes Matheusii* Kze. (*Ch. pruinata* Klf.)

found near Rio Blanco in the vicinity of Mount Aconcagua. I have seen no other nor am I absolutely sure of the identity of this species, but in no case is it to be confused with the more common *Cheilanthes glauca*. Between the dry rocks of the mountains appear very seldom *Pellaea ternifolia* Link, *P. myrtillifolia* Mett., and *P. andromedifolia* Fée. I have only seen the first two of these. In the high altitudes of the Andes opposite the city of Santiago, there once åppeared *Blechnum* (*Lomaria*) *Germainii* Christ, which is more frequent in the South. According to a report which has just been published there exists there the *Polystichum vestitum* Pr., frequent in the South of Chile, the Juan Fernandez Islands and New Zealand. To the same genus belongs a beautiful find which I made several months ago consisting of *Polystichum mohrioides* Pr. (forma *latifolia* Hicken), which was growing among the high rocks at 2,300 meters heights in the Andes just in front of Santiago (Cordillera del Abanico, the Fan Range). This fern has a very large area of dispersion which commences in the Polar Seas of the South (Amsterdam, Marion and Falkland Islands) to continue by way of Fuegia, along the Andes to the western part of the United States. In all of Northern and Central Chile it must be very scarce. For the latitude of Santiago, I know no other previous find.

In the books still various other ferns are indicated as existing in Central Chile; but I believe this is due largely to errors. Nevertheless, a very few times specimens of the genus *Ophioglossum* (*O. meliphillense* Remy) have been found.

Carl Reiche, who worked a great deal on the Chilean flora, indicates *Ophioglossum crotalophoroides* Walt. at Los Vilos. It has also been found near Valparaiso, and I have had occasion to examine 14 fertile examples of

50 to 100 mm. in height attributed to this species by his collector, Prof. V. M. Baeza, found on a little hill of Peñaflor a little southwest of Santiago. From Zapallar (a little North of Valparaiso) I have seen various very typical specimens of *Polypodium synammia* C. Chr., collected by F. Johow and M. Gusinde. It is to be found sometimes in the woods near the coast of Valparaiso and Santiago, but I have never had the good fortune to find it. From Marga-Marga (near Valparaiso) I know a very characteristic example of *Polypodium lanceolatum* L. found by Dr. O. Tenz. The scales which this species has on the lower surface of the leaf could be readily seen. I have also seen specimens of *Pteris chilensis* Desv. (El Salto) and *Hypolepis rugosula* J. Sm. var. *Poeppigii* C. Chr. & Skottsberg (Quilpué, Marga-Marga, Zapallar). collected a few kilometers from Valparaiso. These two ferns and the above mentioned *Polypodiums* are common in the humid region of the South of Chile. *Pteris chilensis* has also been found by Meigen in the Andes neighboring on Santiago. The typical locality of the Chilean form of *Hypolepis* (*Polypodium Poeppigi* Kze.) is in this same zone (Concón, a little North of Valparaiso). In the Zapallar also, Dr. F. Johow once found *Asplenium obtusatum* Forst. of such extensive geographical area, and *Dryopteris spectabilis* C. Chr. Reiche also cites this latter at Quintero in the same region, and in a private herbarium I saw an example collected in Tanumé, province of Colchagua, about 200 kilometers farther south. Both ferns are common in the South of Chile and *Dryopteris spectabilis* is the species of this numerous genus which reaches farthest south in America.

With our present knowledge it is not possible to draw phytogeographical conclusions in regard to the ferns of Central Chile. Nevertheless, it is fitting that it appear that on the coast there are many more ferns than in the

DRYOPTERIS ARGENTINA (A SMALL SPECIMEN).

interior. This is due to the fact that the coast is more humid, that it rains more there, and that frequent fogs rise from the sea. Nearly all the "scarce" species previously cited, I know only from the coast and we have even two species that are epiphytic (*Polypodium synammia* and *P. lanceolatum*). This is not a characteristic of the ferns but of the vegetation of Central Chile in general. The coast has a more hygrophyle and more varied vegetation, while in the interior, starting south of Santiago, reign without rival the barren plains of bushes and herbs.

Many notable species are seen exclusively on the coast, do not advance to the interior or are very scarce in this latter region. I have already discussed elsewhere this question of botanical geography which, according to my opinion, the botanists who have written on Central Chile had not made sufficiently evident.

The Chilean ferns that have been mentioned are nearly all delicate plants that very poorly bear the influence of man. They do not have the slightest tendency to become weeds, except *Equisetum bogotense* and *E. pyramidale*, which occasionally invade abandoned cultivated fields. It is also customarily seen along the roads just as is the *Adiantum*, but generally in small quantities. Various Chilean ferns may be cultivated very well, especiallly *Dennstaedtia lambertiana*, and also *Dryopteris argentina*, *Blechnum chilense* and *B. auriculatum*. They are seen occasionally in the gardens and parks of Chile, but they have not yet achieved the propagation that their beauty merits due to the fact that as yet no one has bothered about propagating them in a methodical manner.

SANTIAGO, CHILE.

Some Reminiscences of Fern Collecting

DOUGLAS H. CAMPBELL

My own special interest in ferns goes back to my student days at the University of Michigan. There I was introduced to the epoch-making investigations of Hofmeister on the comparative morphology of the Archegoniates, and for several years subsequently I was occupied with the study of the life histories of a number of Pteridophytes.

Some years later, when I joined the little band of Argonauts trekking to California to start Stanford

University, I began preparing material for my book "Mosses and Ferns." The need of types absent from our own country suggested a summer's trip to Hawaii, the most accessible tropical region, and one known to be rich in ferns. This was in 1892, just before the overthrow of the native monarchy, when much of the land, now devoted to sugar and pine-apples, was still covered with virgin forest. This was my introduction to the tropics, and no doubt I then contracted the travel-microbe which has since impelled me to visit many distant lands where ferns flourish.

My collections have comprised relatively little herbarium material, but have consisted, to a great extent, of carefully selected and preserved material suitable for histological study. The great object was to secure material showing the development of the reproductive organs and embryo, especially of certain types which there was reason to believe were the older and more primitive forms, whose development might throw light upon the evolution of the more recent fern-types. Such collections included not only the fully developed fern or "sporophyte," but the often very small and inconspicuous sexual plant—the gametophyte or prothallium—which is quite overlooked by most collectors, but is of the first importance in studying the life-history of the fern.

Two main divisions of the ferns may be recognized, the Eusporangiatae and the Leptosporangiatae, the latter including an overwhelming majority of the living species. It is the Eusporangiates, however, which are of special importance to the student interested in a study of the evolution of the ferns, since the Eusporangiates are the nearest living relatives of the ferns and fern-like seed plants of the Palaeozoic formations. There are two existing orders, the Ophioglossales and Marattiales, most of whose species are tropical in their distribution, and

number only about 200, about one fourth as many as in the single leptosporangiate genus *Polypodium,* the type of the family Polypodiaceae, which are preeminently the predominant modern fern-types, and include all but a relatively small number of living species. Except for the Osmundaceae and a few rare examples of the Schizaeaceae and Hymenophyllaceae, the leptosporangiate ferns of the United States are all Polypodiaceae. The Eusporangiates are represented by a few species of *Ophioglossum* and *Botrychium.*

As one studies the conditions most favorable for the growth of ferns, it is evident that the great majority of species occur in regions where there is ample moisture and relatively uniform, but not too high, temperature. In the tropics it is not the hot lowlands of the equatorial regions that are richest in ferns, but the mountain rain-forests where there are very uniform but moderate temperatures. In these tropical mountain forests, and in some oceanic islands, like Hawaii and New Zealand, ferns constitute a large and conspicuous feature of the vegetation.

In extensive continental areas like the United States, conditions are much less favorable, owing to great extremes of temperature, and more or less marked aridity of much of the country; and ferns are greatly restricted in their range, and the number of species is small compared with the very much smaller area of some of the more favored regions. For instance, the little island of Jamaica, with an area but little over 4,000 square miles —about the same as Connecticut—has probably at least twice as many species of ferns as the whole 3,000,000 square miles of the United States. Moreover, to the student interested in the problems of comparative morphology and phylogeny, the absence from our country of some of the most important families of ferns, or the ex-

treme rarity of the few representatives of others, is a great handicap. Thus we have no representatives of the important families Marattiaceae, Gleicheniaceae and Cyatheaceae; and the Schizaeaceae and Hymenophyllaceae are represented by only a very small number of rare and local species.

Most of the familiar genera of the Polypodiaceae e. g. *Polypodium, Pteris, Adiantum, Asplenium*—are abundantly represented in most tropical forests—where in addition to the many terrestrial species there is a luxuriant development of epiphytic forms, ferns playing an important rôle in the characteristic epiphytic floras of the tropical rain-forests.

Of other Pteridophytes, many species of *Lycopodium* and *Selaginella* are common throughout the tropics—often as epiphytes. A very common and wide-spread species is *Lycopodium cernuum*, which forms dense thickets of upright branched shoots, sometimes 4–5 feet high. This species is very often associated with the equally wide-spread fern, *Gleichenia linearis*. *Equisetum* is rarely met with in the tropics—although there are some very large species—e. g. *E. giganteum*, in the American tropics. Finally about a half-dozen species of *Psilotum* and *Tmesipteris*, mostly epiphytes, repreesnt the class Psilotineae.

On my first trip to Hawaii, besides botanizing in the vicinity of Honolulu, visits were made to the northernmost and oldest island, Kauai, and to the much larger, but more recent island, Hawaii, where there are still active volcanic craters. On Kauai I had the good fortune to find a lot of prothallia and young sporophytes of *Marattia Douglasii*, the only representative of the family in the islands, and this discovery enabled me later to make a fairly complete study of the early history of this species. In Hawaii also, I had my first acquaintance

with tree-ferns in their native haunts. The abundance of these magnificent ferns, with their massive trunks and great fronds, ten or fifteen feet long, was specially evident on my first trip to the volcano of Kilauea. At that time, the highway from Hilo, along which now motor-cars make the journey in an hour or less, was available for carriages only for twenty miles. The remaining 13 miles was made on horseback by a trail through the dense jungle—with extensive groves of tree-ferns, the trunks of which for a mile or more, were used to make a corduroy road. These prostrate trunks, however, were sending out vigorous fronds. The commonest tree-fern of the Islands is *Cibotium Chamissoi*. On my last visit to Hawaii, about ten years ago, it was a great shock to me to find the dense forest, which in 1892 extended almost unbroken from Hilo to the volcano, nearly annihilated, and all that remained of the great groves of tree-ferns were a few wretched remnants along the highway, evidently marked for an early death.

Some of my best collecting was done near Hilo, where a coffee plantation had been started, but where most of the forest was still intact. This is a region of very heavy precipitation, and there was a wonderful profusion of ferns. The trunks of the tree-ferns were often covered with beautiful filmy ferns, and here I saw, for the first time, the extraordinary epiphytic *Ophioglossum pendulum*, while in the crotches of many trees were superb specimens of birds-nest fern (*Asplenium nidus*)—both species characteristic of the eastern tropics.

In the drier and more exposed areas all over the Islands are dense growths of *Gleichenia linearis*—often a great nuisance to the collector, as these thickets are quite impenetrable.

These were only a few of the ferns new to me, but were enough to whet my appetite for further wanderings in the tropics.

Five years later I visited a region which perhaps has the richest fern-flora of any region of equal extent. The island of Jamaica is about 150 miles long with a maximum width of about 50 miles; but within this limited area are mountains over 7,000 feet high, and an extraordinary range of temperature, rainfall, and soil conditions. I can recall no fern-flora equalling this in luxuriance and variety, especially in the upper portions of the Blue Mountains, where from minute, almost microscopic filmy-ferns, to tree-ferns forty or fifty feet high, ferns in bewildering variety were the predominating type of vegetation. The total number of species of ferns and other Pteridophytes in Jamaica is said to be about 500.

Of most interest to me were the Marattiaceae. *Marattia alata* is common, and there are several species of the strictly American genus *Danaea*. A second visit to Jamaica was made some years later, especially to secure material of *Danaea* for embryological study. On this second trip I also secured material of the rare epiphytic *Ophioglossum palmatum*—a species also recorded from Florida.

A sabbatical year, 1905–06, made possible a visit to the East Indies, where several months were passed in Java. Here one may study most satisfactorily the extremely luxuriant equatorial vegetation, which can scarcely be equalled in any part of the world.

Having been invited to attend the meeting of the British Association for the Advancement of Science meeting in South Africa, an opportunity was given to see something of the very peculiar and beautiful flora of that region; and while the ferns are not especially abundant, some interesting species were noted. Near Cape Town, material of *Gleichenia polypodioides* was collected, and the fine fern, *Todea barbara*, was frequent. The latter plant, one of the Osmundaceae, I later saw also in Australia.

From South Africa the long voyage up the East Coast of Africa, and across the Indian Ocean brought me to India, where little opportunity was afforded for botanizing. In Ceylon, however, several weeks were spent, and some good material secured; but Ceylon is not to be compared in the abundance of ferns to the great islands of the East Indies, Java, Borneo and Sumatra. Nevertheless, some good material of *Angiopteris*, one of the Marattiaceae, was secured near the beautiful botanical gardens of Peradeniya, and also some fern material from the higher elevations was collected. Perhaps the most interesting find was that of *Helminthostachys Zeylanica*, a monotypic genus of the Ophioglossaceae, which grew in abundance in a forest reserve near Hanwella, in the lowland. Here were great numbers of very small plants which were still connected with the subterranean gametophytes. The forest lay near a river, and it was evident it had been inundated at no very distant period. It is quite likely that the germination of the spores requires such submergence. From some of the trees, remarkably fine specimens of *Ophioglossum pendulum*, with ripe spores, were collected. Some of these forked pendant fronds were nearly two yards long, and the sporangial spikes 5–6 inches. Ripe spores collected at this time were successfully germinated.

It was not until Java was reached that I fully realized the richness of the East Indian fern-flora. The great botanical gardens of Buitenzorg are world famous and fully deserve their reputation. There is a magnificent fern collection, and the neighboring country affords some extraordinarily interesting collecting ground.

One of my principal objectives was to obtain material of the gametophytes and embryos of *Ophioglossum*, and when I reached Buitenzorg, I found to my delight, a small *Ophioglossum* growing like a weed all over the

Ferns in the Botanical Garden, Buitenzorg, Java.

garden. There seemed to be more than one species, but the only one to be identified was *O. Moluccanum* (= *O. pedunculosum*). After many hours' work spent in searching for the minute subterranean prothallia, I succeeded in securing a considerable number, and felt amply rewarded for my labors.

Among the common ferns of the lower country were several species of *Lygodium*, and this genus seems to be most abundant in the hot lowlands.

With a native collector excursions were made in the neighborhood. One of these, to the base of the volcano, Salak, yielded a good lot of *Kaulfussia* (*Christensenia*) *aesculifolia*, a very peculiar member of the Marattiaceae. The palmately divided, single leaf, as the specific name indicates, is much like the leaf of the horse-chestnut, not only in form, but in the reticulate venation. A fine lot of prothallia and very young sporophytes furnished material for a quite satisfactory study of the life history of this extremely isolated type. Two other Marattiaceae, *Marattia sambucina*, and *Angiopteris erecta*, are common and conspicuous, the latter a gigantic fern with leaves sometimes more than five meters in length. There are very fine examples of this fern in the Buitenzorg garden. The richest collecting ground in Java, however, was at the mountain station Tjibodas, where I spent several weeks. This is a branch of the Buitenzorg garden, and is provided with excellent laboratory and living accommodations. It is at an elevation of about 1,400 meters on the slopes of Mt. Gedeh, a volcano whose highest peak, Pangerango, is about 10,000 feet high. Immediately adjoining the garden is the virgin forest extending to the mountain summit and affording the finest collecting ground for liverworts and ferns that I have ever seen.

The profusion of these plants is extraordinary, and as there was ample time for selecting and preparing mate-

rial, I brought away the most valuable and extensive collection that I have ever made from a single locality.

First in importance was the discovery of a great quantity of the prothallia of *Ophioglossum pendulum*—one of the things I had especially hoped to get. Noticing a number of small specimens of the *Ophioglossum* attached to a big bird's nest fern on the branch of a tree, one of the native boys was sent to climb the tree and cut down the fern, with the attached *Ophioglossum*, I found the masses of humus between the leaf-bases of the *Asplenium* simply packed with hundreds of the gametophytes of the *Ophioglossum*—a veritable treasure-trove!

Tree-ferns are abundant everywhere, but reach their finest development in the middle and upper forest zones. These include about a dozen species of *Alsophila*, *Cyathea*, *Hemitelia*, and *Dicksonia*. *Alsophila glauca*, a wide-spread species throughout the Indo-Malayan regions, is the tallest, sometimes exceeding forty feet in height. Hymenophyllaceae are extremely abundant, mostly epiphytes, but some species of *Trichomanes* also growing on the ground. Some of the smaller species of *Hymenophyllum* occur in the forest near the summit of Pangerango, and fine tree-ferns were seen at elevations of at least 8,000 feet. At the upper levels were also some very large *Gleichenias*—*G. vulcanica*, *G. arachnoidea*.

While in Java, I had an opportunity of visiting the Island of Krakatau, which was largely destroyed by a terrific volcanic explosion in 1883. All vegetation was destroyed, but three years later, eleven species of ferns, including the cosmopolitan *Pteris aquilina*, had already established themselves on the ashes thrown out by the volcano, and constituted the major part of the new vegetation. By the time of my visit (1906), the ferns had been to a great extent supplanted by other vegetation.

In 1912–13 a second visit was made to the East Indies, and some time was spent in the Federated Malay States,

Borneo, Sumatra, and the Island of Luzon, in the Philippines. This trip also included a brief visit to Java, but very little time was given to collecting.

The conditions in the Malay Peninsula are less favorable for ferns than in Java. The mountain chain forming the back-bone of the Peninsula, is mainly composed of granite, and the coarse granitic soils, found in many places, are less suited to the growth of ferns than the rich volcanic soils prevailing in Java. However, some ferns, especially Gleicheniaceae, seem to prefer these granite soils, and I have nowhere seen them more abundant or luxuriant than in the Malay States. In the low country, two species of *Lygodium* were very common.

Excursions into the higher country at elevations from 2,000–4,000 feet showed a notable increase in the fern-flora. At about 2,500 feet, tree-ferns—especially *Alsophila glauca*—were very fine. Of the Marattiales, only a few specimens of an *Angiopteris* were seen. Epiphytic ferns, Hymenophyllaceae and especially many species of *Polypodium*, were abundant. The most interesting fern met with at this time was *Matonia pectinata*. This, with a second species, afterwards collected in Borneo, are the only known living representatives of the family Matoniaceae, which, however, includes many fossil ferns.

Matonia, for a long time known only from Mt. Ophir, in Malacca, also occurs in various mountain regions as far north as Luzon. I found it growing in a boggy spot at about 4,000 feet elevation, associated with *Sphagnum*, Pitcher-plants (*Nepenthes*) Orchids, Rhododendrons and other Ericaceae. Another characteristic fern, *Dipteris*, which in habit somewhat resembles *Matonia*, was growing here also. Both have stately fronds, with upright stipes sometimes 5–6 feet high, and a broad fan-shaped lamina.

During my stay in the Federated Malay States, I made a brief visit to Sumatra, but found nothing especially

characteristic in the way of ferns, most of them being very similar to those I had collected in Java on my former visit to the East Indies.

While completing my monograph of the eusporangiate ferns[1], a new genus, *Macroglossum*, was published by Dr. E. B. Copeland. This very characteristic genus was based upon material from Sarawak, in western Borneo, and to obtain material of this new fern I decided to visit this extremely interesting country. Dr. Copeland kindly gave me letters to those who had collected the original specimens, and I was successful in securing a very satisfactory lot of material. Another fern I especially wished to get was *Matonia sarmentosa*, known only from some limestone caves in Sarawak, in the same region in which the *Macroglossum* was first collected.

Sarawak is a country of about 50,000 square miles in extent, unique in its history, as it is a hereditary monarchy ruled by an English rajah. It is only comparatively recently that it has accepted a protectorate from the British Government.

Two days' sail from Singapore brings one to the mouth of the Sarawak River—or rather the delta—and as the steamer proceeds up stream on either side are mangrove swamps, where at low tide the mud flats are the abode of crocodiles and other less formidable creatures, like the crabs and mud-fish which scramble over the slimy ooze.

As the salinity of the water decreases up stream, and the banks became higher, the mangroves are replaced by palms of many kinds, and myriad types of trees, shrubs and creepers.

Kuching, the capital, where I made headquarters, is a picturesque town whose Chinese origin is evident from

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[1] The Eusporangiatae, the Comparative Morphology of the Ophioglossaceae and Marattiaceae. Carnegie Institution of Washington. Publication No. 140. 1911.

its temples and other characteristic buildings. Lying within one degree of the equator, Kuching has a uniformly hot and humid climate, where the vegetation shows a luxuriance which few places, even in equatorial lands, can equal. For the three months before my arrival over a hundred inches of rain had fallen.

Exploration of the dense jungles was a rather serious problem. Except in the immediate vicinity of Kuching, one had to depend on the many streams, or forest trails, the latter often under water, and not available for either saddle or pack animals. Incidentally, swarms of mosquitoes and leeches—the latter especially numerous and voracious—did not add to the pleasure of these forest excursions.

My first expedition, which through the courtesy of Mr. J. G. Moulton, director of the Sarawak Museum, who accompanied me, was eminently successful, was a hunt for *Macroglossum*, and the rare *Matonia sarmentosa*. We camped in a government bungalow, not far from Bau, where there are important gold mines. For transporting ore, a very narrow tram-way has been built and we were able to utilize this for part of our excursions. The little flat-cars were propelled by a man standing up and pushing with a pole! On one occasion my motors were a Sikh policeman and a convict in his charge.

Our first expedition was to some limestone caves in search of *Matonia sarmentosa*, which we saw hanging down from the roof of a cave some 50 feet high in the side of a cliff, accessible only by a very rickety native ladder, which we hardly ventured to ascend. However, the manager of the mines arranged with some of the native Dayaks to secure specimens for us, and they were later sent to Kuching. The caves where these ferns are found are the haunt of the swifts whose gelatinous nests are so highly prized by the Chinese.

Macroglossum Alidae, the fern for which I had especially come to Borneo, had been discovered in this region by my host, and he was able to give me such explicit directions as to where it grew, that we soon found it. I shall not soon forget my sensations, when just where we had been told, we found our plant—a magnificent fern with stately upright fronds more than four yards long. A happy morning was spent collecting prothallia and young plants for future study.

Perhaps my most interesting experience was a week spent on Mt. Mattang, about ten miles from Kuching. Accompanied by my Chinese boy, and half a dozen coolies carrying on their heads the necessary impedimenta for a week's camp (including a crate of chickens and one of the huge pine-apples for which Sarawak is famous) I was soon comfortably established, and for the time being monarch of all I surveyed. At about 1,000 feet altitude is a bungalow belonging to the Rajah, the use of which was placed at my disposal. Except for some small clearings planted to tea and coffee, the mountain is covered with virgin forest. Botanically this region is specially notable, as Beccari, the noted Italian botanist, spent much time at this place, and described many new species, especially palms, from Mattang. A great variety of ferns was noted and I found one plant of *Macroglossum*—a new station for this fern.

Aside from the ferns, the vegetation of Borneo is exceedingly rich and interesting. Probably no part of the world is richer in palms and orchids, and in Borneo the Pitcher-plants (*Nepenthes*) attain their greatest development. These are only a few samples of the immense number of species making up the flora of this great island.

Before returning to America, a stay of about six weeks in Luzon, the north island of the Philippines, enabled me

to see something of the ferns of the region. Several excursions into the mountains in the vicinity of Manila and Baguio,[2] gave opportunity to compare the Philippine fern-flora with that of the great islands of the Sunda archipelago. Most of the types found in the latter also are found in the Philippines, as might be expected, since these are the northern members of the great Malay archipelago.

Outside the tropics, the temperate regions of the Southern Hemisphere, where sufficiently moist, have the richest and most interesting fern-floras. Southeastern Australia, and especially New Zealand, are good illustrations. While the number of species is much less than in Java or Jamaica, for example, nowhere do ferns show more luxuriant growth than in parts of New Zealand. Although these countries lie well outside the tropics, their climate is much more uniform than that of regions in corresponding latitudes north of the equator; and when there is abundant moisture, as in western New Zealand, conditions are exceptionally favorable for the growth of ferns. Both in Australia and New Zealand, tree-ferns are especially abundant and luxuriant.

Only a relatively small part of Australia is suited to the growth of ferns. A narrow strip of land along the east coast is well watered, and here are the highest mountains, none of which, however, much exceed 7,000 feet elevation, while most of them are less than half as much. In North Queensland, which lies well within the tropics, ferns are not noticeably abundant, although such tropical genera as *Marattia*, *Gleichenia*, *Lygodium*, occur. Owing probably to the long dry season, epiphytic ferns are relatively scarce; but one genus, *Platycerium*, is especially characteristic and conspicuous, and forms great clusters high up in the trees.

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[2] I am greatly indebted to Dr. E. B. Copeland, who accompanied me on these expeditions.

In the southeast of Australia, including much of Victoria, and parts of New South Wales, are the highest mountains, and there is ample rain-fall. In these regions ferns are abundant and include some very characteristic forms.

One of the most interesting districts, botanically, in New South Wales, is that of the Blue Mountains, west of Sydney. These form the edge of the elevated plateau which slopes westward to the plains of the interior. The highest point is about 4,000 feet, and in places deep and abrupt gorges cut through the sandstone, are well watered, and support a rich and beautiful flora.

In company with the late Dr. A. A. Lawson, Professor of Botany in the University of Sydney, I spent a couple of days at Wentworth Falls, close to one of the finest of these gorges. The region is a rather dry table land, about 2,000 feet elevation, and covered with small scattered eucalyptus trees, and a great variety of shrubs, and a few herbaceous plants. Many of these shrubs have beautiful flowers—mostly unfamiliar to the botanist from the Eastern United States, although less so to one from California, as we grow so many Australian plants in our gardens. Ferns were almost entirely absent from this dry plateau, but a few specimens of the curious *Schizaea bifida* were seen growing in the barren sandy soil.

The bottom of the gorge supports a fine forest, with several species of Eucalyptus predominant, but also with a good many other trees. Following the steep trail into the gorge, a number of interesting things were noted on the rocky banks along the trail. These included species of *Lycopodium* and *Selaginella* and two species of *Schizaea*. *S. rupestris* grew in wet rocks in company with species of *Lycopodium*, *Drosera*, *Sphagnum*, and other bog plants. *Gleichenia*, of which there are four species in this region, was also noted.

Eucalyptus Forest, Victoria, Australia. The Tree Ferns are Dicksonia antarctica.

The finest development of ferns, however, was in the damp shady gullies near the bottom of the gorge. Clear streams with falls and cascades had luxuriant growths of ferns bordering them, presenting a wonderfully beautiful picture. Extensive groves of tree-ferns with slender trunks, twenty feet or more in height, had crowns of fronds very luxuriant and perfect. Seen from above, this carpet of interlaced giant fronds was extraordinarily beautiful. These fern-groves were composed of two species, *Alsophila australis* and *A. Cooperi*.

Next to the tree-ferns, the handsome *Todea barbara* was most conspicuous. It sometimes develops a short trunk, but can hardly rank as a tree-fern. Related to this is *T.* (*Leptopteris*)-*Fraseri*, which like two closely related New Zealand species, needs abundant moisture, and was constantly wet with the spray of the falls. It has thin, translucent foliage like that of the filmy ferns. The latter were represented by several small species of *Hymenophyllum* and *Trichomanes*, but I was told these were much more abundant at higher elevations.

Most of the familiar genera of Polypodiaceae, e. g. *Pteris*, *Blechnum*, *Asplenium*, *Adiantum*, etc., are well represented—over forty species are recorded from the vicinity of Wentworth Falls.

In eastern Victoria, a region of heavy rainfall, there are forests of giant eucalyptus, where tree-ferns abound; but on the whole the ferns are less varied than is the case in the warmer regions of New South Wales. *Dicksonia antarctica* is the predominant tree-fern, but *Alsophila australis* also occurs.

While in Australia only a limited area is suited to the growth of ferns and other moisture-loving plants, New Zealand is notable for the luxuriant development of ferns over a large part of its surface. A markedly insular climate, and adequate moisture, contrast greatly with

conditions in most of Australia. The major part of New Zealand consists of two large islands, lying between S. lat. 34°–48°.

The west coast of the south island has a very heavy rainfall, and the fern vegetation of this region rivals the richest tropical rain forests in the luxuriance of the ferns, although the number of species is much less.

The north island was originally largely covered with heavy forest, in which the giant Kauri pine (*Agathis australis*) was the most important tree. I visited one of the last stands of these great trees, and noted several characteristic ferns. These included *Blechnum Fraseri*, *Dicksonia lanata*, and a very fine tree-fern, *Cyathea dealbata*, easily recognized by the silver underside of the leaflets. In many parts of the north island, another common tree-fern, *C. medullaris*, reaches a gigantic size, sometimes fully 50 feet high, with magnificent fronds—on the whole, I think, the handsomest tree-fern with which I am acquainted. Another species from the Kermadec Islands, north of New Zealand, is reported to reach a height of 70 feet.

Other ferns of the north island are *Todea barbara*, *Schizaea dichotoma*, and species of *Gleichenia*.

In the south island the Southern Alps, a snow-clad range culminating in Mt. Cook, 3,766 m. high, are separated from the west coast by a strip of land only about ten kilometers wide. This area to the west of the mountains is known as Westland, and has an excessively heavy annual rain-fall—200 inches at some stations. There is a heavy forest growth in which practically all vegetation is evergreen. The dominant trees are species of *Podocarpus* and *Dacrydium*, members of the Yew family, so that this is sometimes called a "Taxad" forest.

This forest is one of extraordinary luxuriance, and the profusion of lianas and epiphytes, and the magni-

ficent development of tree-ferns, give the impression of a true tropical jungle. This impression is not lessened when we analyze the constituents of the vegetation; for a large proportion of the trees and shrubs are related to tropical types rather than to those of more temperate latitudes. To the northern botanist it is a genuine surprise to see a forest of this kind in latitudes corresponding, in the United States, to that of Boston or Buffalo.

While palms are wanting, their place is taken by the magnificent tree-ferns, which are everywhere abundant, and often 30–40 feet high. The commonest is *Dicksonia squarrosa*, a much more beautiful species than *D. antarctica*. *Hemitelia Smithii*, a smaller, but handsome, species, also occurs.

In this rain-forest ferns are extremely abundant and luxuriant. In addition to many species of the familiar northern genera, there are several peculiar types. Two species of the striking genus *Leptopteris*, of the Osmundaceae, are common. Their finely cut feathery leaves have the delicate translucent appearance of Hymenophyllaceae. The latter are developed here on a scale that can hardly be matched anywhere. They grow on the ground, on fallen logs and stumps, but especially draping the trunks and branches of the trees. The rough trunks of the tree-ferns are a favorite habitat for these exquisite ferns. Epiphytic Lycopodiums, and the curious *Tmesipteris* are also characteristic of the rain-forest. The species of *Hymenophyllum* are more numerous than those of *Trichomanes*. One of the latter, however, cannot fail to attract the attention of the collector. *Trichomanes reniforme*, which is very common, has entire kidney-shaped leaves, which are somewhat leathery in texture, and of a vivid green—very different from the deep green semi-transparent leaves of most of the family.

STANFORD UNIVERSITY, CALIFORNIA.

Variation in British Ferns

F. W. STANSFIELD

On behalf of the British Pteridological Society, we send to all American fern-lovers a friendly greeting. Some of them have paid us visits which have been mutually agreeable, and we trust the custom may develop into a habit. Our common language makes communication of ideas between fern-lovers across the Atlantic more easy than is practicable in the case of many nearer neighbors who are hampered by differences of speech.

Whereas in America the study of ferns is mainly one of the determination and distribution of species, in our own smaller country we have for many years taken up the study of variation within the limits of the several species and this has furnished us with abundant occupation, and an ever increasing series of problems in biology, morphology and cultivation. Although varieties have been known among British ferns for more than two hundred years, it was not until the middle of the last century that the collection and study of them was seriously taken up. For a time their accumulation became a rage (*i.e.*, during the 60s and 70s of the 19th century), so much so that the most trivial variations, not excepting actual deformities, were eagerly collected and named. This excess naturally produced a reaction, and, for a time, botanists regarded the "so-called varieties" with some contempt. Nevertheless, a certain number of people persisted in collecting and cultivating varieties, but gradually became more critical and less easily satisfied as to the value of certain variations. Forms exhibiting mere depauperations and eccentricities were dropped and disregarded, and attention was concentrated on those showing increased development of certain parts and especially on those tending to greater division of the segments. Tasselling of the ex-

tremities was still admired so long as the symmetry of the frond was maintained, but the "plumose" conditions began to be regarded as the most important addition to the beauty of a species.

This character consists in the increased growth of the leafy part of the frond, sometimes with a thinning in texture, and often, if not generally, with a partial or complete loss of fertility. Among our 42 British species this form of variation has been found in at least eleven, *viz.*: in *Adiantum Capillus-Veneris, Blechnum Spicant, Phyllitis Scolopendrium, Asplenium marinum, A. Trichomanes, Athyrium filix-foemina, Polystichum aculeatum, P. angulare, Dryopteris filix-mas, D. montana* and *Polypodium vulgare*, with some approach to it in one or two other species. In *Athyrium* some eight or nine different "*plumosums*" have been found wild and many others have been raised under cultivation. In *Polystichum angulare* also five or six have been found, while in *Phyllitis Scolopendrium* we are well within the mark in saying that over a score of distinct "*crispums*" ("*crispum*" is the plumose form in this species) have been found wild and this number is being added to year by year.

In *Polystichum angulare* the variations were classified by E. J. Lowe in 1891 into 28 sections, and these were distributed among 4 divisions, each subdivided into several groups. The divisions were:—

A. changes in skeleton; 6 groups and 10 sections.
B. changes in soft parts; 4 groups and 15 sections.
C. alteration in outline of frond; 2 sections.
D. alteration in colour of frond (variegation).

Altogether he describes 369 varieties of this one species and although many of these have been lost, yet the number in cultivation is probably considerably larger than in Lowe's time. In this species especially we have advanced beyond the plumose section and developed an ultra-plu-

mose type, most of which are known as "*pulcherrimums.*" Some sixteen *pulcherrimums* have been found wild but only two or three of these remain in cultivation, the others having proved too ethereal for this world. It has been found, however, that by sowing the spores of the finest plumose divisilobes a small proportion of *pulcherrimums* can be raised, and these can be recognized in a very early stage of growth by the pellucid and prothalloid appearance of the primary frond. They require extreme care in their infancy and are quite easily lost afterwards. They are, however, well worth all the care that can be bestowed upon them, as, when well developed, there is no fern more attractive to the eye than a good *angulare pulcherrimum.*

It is a curious fact that the hunt for varieties has been so much more energetic and productive in the British Islands than elsewhere, but, nevertheless, varieties have been found in other lands, notably in the Atlantic Islands (Azores and Canaries) and also on the American continent, especially towards the Pacific coast, where the climate is doubtless more humid than in the eastern and central states. May we venture to hope that our American friends will extend more attention to this fascinating branch of botany?

READING, ENGLAND.

WOODWARDIA AREOLATA IN THE VICINITY OF NEW YORK.—A few words about *Woodwardia areolata* in the vicinity of New York may not be inappropriate in view of Mr. Frank W. Pugsley's article in the July–Sept., 1929, AMERICAN FERN JOURNAL.

Formerly, *Woodwardia areolata* was regarded as rare in New York State. Torrey in "A Catalogue of Plants Growing Spontaneously within Thirty Miles of The

City of New-York," 1819, lists it only from Long-Branch, N. J., and his "Flora of the State of New-York," 1843, gives one record on Staten Island "about 3 miles south of the Quarantine" and cites Mr. Cooley for Long Island. D. C. Eaton in "The Ferns of North America," 1879, says it occurs "at Wading River, and near Hempstead, on Long Island; and is by no means rare in the lower portions of New Jersey." Similarly Britton in 1889, "Catalogue of Plants Found in New Jersey," reported it common in the middle and southern counties. Dr. Smith Ely Jelliffe "The Flora of Long Island," 1899, gives one locality in Kings, three in Queens, and Greenport in Suffolk County. When I first found the plant in 1902 at "Fairy Dell" near Quogue, Long Island, growing with *Thelypteris simulata*, I regarded it as a rare find. (It may be of interest to note that, although it grows in profusion at "Fairy Dell," I never found any fertile fronds there.)

More recently, the correct status of this fern near New York City has been generally recognized. Dr. Philip Dowell in "Distribution of Ferns on Staten Island" (Proc. S. I. Assn. Arts and Sciences, May, 1906), classes *W. areolata* as common on Staten Island, abundant in places. Dr. Witmer Stone "Plants of Southern New Jersey," 1911, says it is plentiful in the Middle and Pine Barren districts. Norman Taylor "Flora of the Vicinity of New York," 1915, reports it as "Common on L. I. and S. I." and in N. J. "increasing and common southward, especially in the pine-barrens," in addition to a few records in the northern counties. Finally, Dr. Homer D. House "Annotated List of the Ferns and Flowering Plants of New York State," 1924, reports this fern correctly for New York as "Frequent or locally abundant along the coastal region of southeastern New

York.'' Gray's New Manual of Botany, 7th Ed., 1908, is, to say the least, misleading in generally referring to it as "rare."

Of course, *W. areolata* does not grow in salt marshes, but I have found Clute's statement in "Our Ferns in their Haunts," 1901, correct, that it loves their vicinity. *Thelypteris simulata* is a not unusual companion on Long Island, although not quite as common. In passing, I may add that *T. simulata* is much commoner on the South Shore of Long Island than would be indicated by Dr. House's list.

It is remarkable that a plant as conspicuous and fine as *W. areolata* should have been so often overlooked. It was not found in Canada until 1920, when Prof. Fernald found it in Nova Scotia (*Rhodora*, Aug., 1921), and later in 1921, it proved to be "rather frequent" in certain localities—*Rhodora*, Aug., 1922. There seems to have been something elusive about this fern in the past, when we consider how generally it may be found in suitable localities. It is very abundant, and grows in profusion, along with *T. simulata*, along the South Shore of Long Island, near the railroad, from Freeport to Babylon (and I assume beyond) in almost any patch of wet woods, and I have found it without difficulty near Hewlett on the "Peninsula" to Far Rockaway. It is abundant on Staten Island near South Avenue, at Grassmere, common along the brook near the Moravian Cemetery, and generally in the Tottenville district. I have found it in Bergen County, N. J., as cited by Taylor and I should suppose that careful search would probably find it common in Connecticut near the coast. (See Catalogue of Flowering Plants and Ferns of Connecticut, 1910).

The obtusilobata form of Waters (Ferns, 1903) as described and illustrated by him (pp. 128–129) is usual

on Staten Island, and I have a pretty complete series between the fertile and sterile fronds, although I have none from Long Island. Oddly enough, I have found the so-called var. *obtusilobata* of *Onoclea sensibilis* very common near Bull's Head on Staten Island, although I have found this also on Long Island.—FREDERICK W. KOBBÉ, *New York City.*

CAMPTOSORUS AS A WALL FERN.—Peanuts, cotton, hams—these are the things one associates with Smithfield and its immediate vicinity. Surely one does not expect to find *Camptosorus rhizophyllus* in this section of Tidewater Virginia, and is surprised to come upon a good sized colony of it walking leisurely from crack to crack in the mortar between the bricks of Old St. Luke's Church.

Old St. Luke's is located at Benn's Church, a short distance to the southeast of Smithfield. It is so easy of access to motorists from Norfolk or to those who cross the new four and a half mile James River bridge just above Newport News on their way to, or from, the historic battle grounds of Virginia, that it seems worth while to call the attention of fern lovers who chance that way to the accessibility of this interesting colony.

That the bricks in the lower wall date back to 1632 raises many queries, for it is on the old wall that the ferns are to be met and not in the recently restored portion. How old is the colony? How did it come to plant itself in this section of the country devoid, as it is, of limestone rock? How far did the spores travel? Was it from the nearest recorded station twenty-five miles away in the heart of Dismal Swamp on the trunks of gum trees? Is either of these the parent colony, or do they have a common ancestry? Is there a stepping place between the two colonies? One wonders.—ADDIE JAYNE, *Hampton Institute, Virginia.*

TWO STATIONS FOR ASPIDIUM SIMULATUM IN PENNSYLVANIA.—For a number of years I have been looking for *Aspidium simulatum* and on July 22, 1929, at George Wagner's farm, Pocono Lake, Monroe Co., Pennsylvania, I found it. It was growing in sphagnum along a creek, in the shade of *Viburnum cassinoides*, and both *Aspidium noveboracense* and *A. Thelypteris* were growing within a few feet of it.

Three days later, July 25, two colonies were found at Little Pond Bog, Pike Co., Pennsylvania. They were small colonies, and one of them was within two feet of the spot where, three years ago, I thought I had found *simulatum*, but what I had proved to be only *Thelypteris*. *Aspidium Thelypteris* and *Calla palustris* grow close to this small clump of *A. simulatum*.

On a visit to this same bog on September 3rd a very large colony of *Aspidium simulatum* was found, in an open, sunny place carpeted with deep sphagnum moss. The many weeks of drought the past summer made it possible to scout around more than I had attempted on previous visits. Large clumps of *Osmunda cinnamomea* grew with the colony of *Aspidium simulatum*.

Specimens from both stations have been deposited in the National Herbarium at Washington.—MARGARET S. STRATTAN, Wilkinsburg, Pa.

THE HABITAT OF DRYOPTERIS DILATATA.—The following extract from a letter of Dr. Christensen is of interest.

"Concerning your question as to the growing-places of *Dr. dilatata* I can say little. Denmark is a lowland with few localities reaching 100 meters above sea-level. *D. dilatata* occurs here in plenty in many places, mostly in shady, rather humid forests of beeches and conifers and besides (in a special form) in bogs, for instance, at the foot of old trunks of *Alnus*. Our forests have changed

materially during the last few hundred years, but this change is not due to change in external (climatic) conditions, but to human influence. Modern forestry has quite changed the old ill-treated forests, and especially the introduction of a conifer (*Picea excelsa*), which before 1800 was unknown in our flora, but now as a forest tree is the second after *Fagus*, has highly changed our landscape. It is very probable that the forestrial treatment of our woods has given improved conditions for the larger wood-ferns, which prefer shade, and it seems to me that *D. dilatata* in more humid places in the Picea-woods has found many favorable growing-places which did not exist before. As far as I remember I have seen the largest colonies of that fern in such woods, but it is by no means confined to them. In the Scandinavian Peninsula, where the forests nearly exclusively consist of coniferous trees, *D. dilatata* is a common fern, at least in the humid west coast of Norway. Dr. Otto R. Holmberg, the editor of the new 'Skandinaviens Flora,' says (pag. 11) on the habitat of *D. dilatata* (by him called *D. austriaca* (Jacq.) Woynar, and rightly, I think) 'In forests rich in herbs, river-valleys, ravines, etc. (in somewhat more humid localities than the following [*D. spinulosa*]; prefers shade; on the hills also in sunny places); it goes up to the lower alpine region; rather common at least in the coast- and mountain-regions; extends to Magerö [the northernmost point of Norway] going farther to the north than *D. spinulosa*, which scarcely reaches the mountain region.' "

DISTINGUISHING WOODSIA AND CYSTOPTERIS.—Very gently and kindly Dr. C. E. Waters has reminded me that when I said, in the last number of the JOURNAL (p. 29), that I could think of no way of distinguishing *Woodsia* and *Cystopteris* except by the nature of their

indusia, I forgot his "Key to the Ferns, based on the Stipes." This was a rather inexcusable piece of forgetfulness, since that key was especially designed to make identifications possible when the usual signs fail; and, sure enough, it works in this case, at least so far as the eastern species of the two genera are concerned. All the four eastern Woodsias have the two fibro-vascular bundles (easily seen with a magnifying glass in a cross-section of the stipe) united, from a point a little above the base upward, into a V-shaped or X-shaped figure. In the two species of *Cystopteris* the bundles are separate to the top of the stipe. They are roundish in *C. fragilis* and oval or flat in *C. bulbifera*. These characters—and Dr. Waters's Key[1] as a whole—are commended to key-makers who find themselves in difficulties.—C. A. WEATHERBY.

THELYPTERIS FRAGRANS (L.) NIEUWL., VAR. HOOKERIANA FERNALD ON THE MAINE COAST.—While we were collecting on Schoodic Peninsula, east of Mt. Desert Island, Maine, and a part of Acadia National Park, my companion, P. M. Patterson, returned from an exploration of a row of shady cliffs with a fern which, he said, was strange to him, but reminded him of Cheilanthes, which he had seen in the southern Alleghenies. I immediately suspected *Woodsia ilvensis*, not rare in those parts, and asked to see a specimen. To my surprise he pulled out of his collecting box a fine frond of *Thelypteris fragrans*. I could hardly wait until he showed me the spot where it grew, and after some minutes' search we came upon a narrow crack in a sheer face of granitic rock which harbored three or four luxuriant plants of the fern. The fragrance was very marked, more so than in the plants I had seen in Vermont and in Quebec, possibly due to the shady situation in which they were grow-

ing. It seemed quite out of place among the typical plants of an acid-soil Canadian woodland and the scant flora of most granitic cliffs in such situations, but the depths of that crack may harbor a slight amount of salts, possibly a relic of the days when the sea washed the cliffs, to which the roots of this fern, normally preferring neutral soils, can penetrate.

Thelypteris fragrans var. *Hookeriana* has been found in a few stations in Aroostook County, in northern Maine; on Mount Kineo, near Moosehead Lake; and near the New Hampshire border in Oxford County, but this is apparently the first record of it from near the coast. The single colony found after a careful examination of the cliffs is small, but well hidden, and should therefore, fortunately, remain inviolate for some time.—G. L. STEBBINS, JR., *Harvard University*.

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[1] The Key was distributed as a supplement to vol. 18, no. 2, of the JOURNAL. Members who have joined since that time and have not received copies of the Key, may obtain it on application to the editors.

I will exchange live or herbarium specimens of San Diego County, California, ferns or fern allies for similar specimens from other states.—F. M. COTA, 3846 Cherokee Ave., San Diego, Cal.

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C. A. WEATHERBY ..... Cambridge, Mass.

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Geographic Distribution of the Species of Equisetum in Relation to their Phylogeny*

JOHN H. SCHAFFNER

The genus *Equisetum* is the surviving remnant of a once extensive phylum of plants. Representatives of the Calamophyta, to which *Equisetum* belongs, were important and characteristic plants of the Carboniferous period and fossils have also been found in the Devonian. Besides what were undoubtedly true *Equisetales*, directly related to our modern plants, the *Sphenophyllales* and *Calamariales* flourished in the Carboniferous and extended somewhat beyond this period. The *Sphenophyllales* were apparently a more primitive group than the *Equisetales*, while the *Calamariales* represented a more advanced group which had not only attained the heterosporous condition but also a very efficient physiological reaction system, giving rise to trees over a foot in diameter and often over 60 ft. high.

In thinking of the most primitive vascular forms we must think of small, slow-growing sporophytes in which there was no sex expression and in which the functional system was still very inefficient as compared with what evolved later in the great trees of all the higher phyla.

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There is no evidence and no special reason for assuming that the direct ancestors of our small surviving homosporous ferns, lycopods, and horsetails were ever much larger than what we find at the present day, although it is true that some of the ancient species of *Equisetites* were considerably larger than any *Equisetum* existing at the present time. The great, heterosporous Calamites could not have been ancestors of *Equisetum*, as is often asserted by geologists, for there is no evidence that evolution ever really moves backward and heterospory is a fundamental progressive movement attained in all the higher phyla of plants and is represented by a regular, orthogenetic evolutionary series which attains its limit a multitude of times in the dioecious condition.

During the Triassic and Jurassic periods, the *Equisetales* became very prominent and were widely distributed over the earth, while the *Sphenophyllales* and *Calamariales* apparently disappeared in the Permian. The characteristic fossils of the Mesozoic are usually described under the name *Equisetites*. Some of these were of large size, as intimated above, the stems being up to 8 in. in diameter, with as many as 120 leaf segments in the sheath, and probably 30–40 ft. high. These large forms of *Equisetites* are still met with in the rocks of the Jurassic period in nearly all parts of the world. As we ascend the geological series from the Jurassic rocks, the *Equiseta* become less numerous and the species smaller until they appear practically identical with living forms. The species of *Equisetites* then either belonged to the genus *Equisetum* or else to a very closely related genus. During the Comanchean period (Lower Cretaceous), the horsetails were apparently still among the prominent forms of vegetation, the species being descendants and hold-over of Jurassic plants. But by the time the base of the Cretaceous (Upper Cretaceous) was reached a

most radical change had taken place and both Monocotyls and Dicotyls, of many of the types prevailing today, had become the dominant land vegetation, the Gymnosperms as well as the Pteridophytes having become comparatively unimportant. Now it was probably during this time that all the species of *Equisetum* (*Equisetites*), just like the Calamites in the Permian, perished from the face of the earth, except a single vigorous survivor which existed somewhere in the region between Mexico and Chile, namely in the mountainous regions of tropical America. Jurassic, Comanchean, and Cretaceous deposits are well represented in this region, so our surviving *Equisetum* relic really could have had a place and habitation in the region where survival is supposed to have taken place. The Tertiary species of *Equisetites* may be regarded as true *Equiseta* coming from this surviving form and thus falling into the recognized lines of the modern species.

Before proceeding with the geographical distribution of our present day species and considering their probable origins in relation to definite geographic regions, it is necessary to present the phylogenetic relationships and sequences as worked out from a comparison with each other of their several morphologies, physiologies, and complexities of reaction during the life cycle as well as with plants presumably lower or higher in the general plant series. In the list below several doubtful species are not included.

PHYLOGENETIC SYNOPSIS OF THE SPECIES OF EQUISETUM.

I. EQUISETA PRIMITIVA. Primitive Scouring-rushes. Stomata in bands of two or more lines each; stems evergreen, large, with whorls of branches; cones apiculate. *E. xylochaetum* Mett., *E. giganteum* L.

II. EQUISETA HIBERNA. Winter scouring-rushes. Stomata normally in single lines; stems evergreen.

much-branched to unbranched; sheath segments and teeth sharply differentiated; cones apiculate. *E. myriochaetum* Schlecht. and Cham., *E. ramosissimum* Desf., *E. debile* Roxb., *E. laevigatum* A. Br., *E. praealtum* Raf., *E. hiemale* L.

III. EQUISETA AMBIGUA. Ambiguous Scouring-rushes. Stomata normally in single lines; stems annual, little or not branched; sheath segments and teeth sharply differentiated; cones not apiculate. *E. kansanum* Schaffn., *E. funstoni* A. A. Eat.

IV. EQUISETA PUSILLA. Little Scouring-rushes. Stomata in single lines; stems evergreen or annual, not branched; teeth not sharply differentiated from the sheath segments; cones apiculate. *E. nelsoni* (A. A. Eat.) Schaffn., *E. trachyodon* A. Br., *E. variegatum* Schleich., *E. scirpoides* Mx.

V. EQUISETA AESTIVALIA. Summer Horsetails. Stomata scattered in bands; stems annual, mostly with branch whorls, not differentiated in color; cones not apiculate. *E. fluviatile* L., *E. palustre* L., *E. bogotense* H. B. K., *E. diffusum* D. Don.

VI. EQUISETA HETEROPHYADICA. Spring Horsetails. Stomata scattered in bands; stems annual, mostly at least the sterile shoots with branch whorls, decidedly differentiated, the fertile at least when young without chlorophyll; cones not apiculate. *E. silvaticum* L., *E. pratense* Ehrh., *E. telmateia* Ehrh., *E. arvense* L.

Now the question may well be asked whether this is really the proper sequence, since it is practically just the opposite from what has been generally accepted for a long time. In most systematic treatments *E. arvense* is put at the very base. But the geological evidence would apparently put the large tropical species as the lowest in the series rather than the E. HETEROPHYADICA. The other method of arriving at a correct conclusion is to compare the supposedly lowest with the supposedly highest, making a catalog of the characteristics that have been added or acquired in the sequence from the one to

the other and then also compare this apparent movement with what has happened in plants much higher in the general scale in respect to the same characters.

Beginning then with *E. xylochaetum* or *E. giganteum*, we have a plant with a long-lived aerial shoot, with numerous whorls of branches, with a large sessile, apiculate, green, terminal cone, and with numerous small cones on the branches. The fertile and sterile shoots are essentially the same. The plant is said to attain a length of 20–30 ft. and the stem is up to 1 in. in thickness. From this condition a series of evolutionary advances is in evidence in the various species groups and in individual species until the extreme is reached in *E. arvense*, in which the following aggregate of 15 new potentialities has been attained:

1. The aerial shoot evolves from the perennial to the annual condition. This movement appears in two other lines of *Equisetum* and has taken place in large numbers of the higher groups of plants.
2. The fertile shoot changes from an abundantly branched condition to a specialized stem without branches.
3. The fertile shoot including the flower has lost nearly all of its chlorophyll and is brown in color. This loss of chlorophyll is a general evolutionary tendency in all the higher flowers.
4. The fertile shoot evolves from a long-lived system to a very short-lived system, withering soon after emerging from the ground.
5. The fertile shoot is developed entirely underground, complete for spore dispersal, and differentiated from the beginning.
6. The cones are more definitely determinate and do not have a vegetative point. This progression toward greater promptness in determination of the reproductive axis is a universal trend in all the higher plants.
7. There is a distinct reduction in the number of sporophylls because of the earlier determination and

this movement is also practically universal in floral evolution.

8. The calyx evolves from a sporangium-bearing whorl to a completely sterile structure, thus giving a definite, sterile perianth, the first to appear among the living species of vascular plants.
9. A prominent peduncle has evolved below the flower, duplicating the corresponding evolutionary movement in *Lycopodium*. The peduncle is very generally evolved in the higher plants.
10. The fluctuation between flower and vegetative tip with the development of intermediate semi-sterile cones is quite rare, while in the species on a lower level it is exceedingly common. In the higher flowering plants intermediate shoots are exceedingly rare, in fact practically non-existent.
11. The fluctuation in the length of the vegetative internodes is less common than in the lower species.
12. The aerial shoots are very much smaller and this movement is prominent in every section of the genus.
13. Proliferation, which represents a return of the reproductive axis to the most primitive condition, is much less common than in species on a lower level belonging to the same general group, like *E. fluviatile* for example.
14. The number of teeth and sheath segments of the branches is very definite in *E. arvense*, being three or four, while in the lower species the numbers fluctuate decidedly.
15. Cones are rarely developed on branches, even in related species where branch whorls are still present on the fertile shoots, while in *E. giganteum* and other low species branch cones are a regular feature.

GENERAL FACTS OF DISTRIBUTION.

The general facts of distribution of *Equisetum* are most interesting when compared with this phylogenetic sequence, which has two culmination points, one in section IV. and the other in section VI. The EQUISETA PRIMI-

TIVA are confined to the tropics and sub-tropics, from Mexico and Cuba to Northern Argentina and Chile. There is apparently but one outside species in this region (*E. bogotense*) and this species is the only one whose distribution does not coincide closely with its taxonomy. From south central Mexico to the Arctic Ocean, North America contains at the least 14 of the 22 recognized species which with the 4 distinctly tropical and subtropical American species leaves but 4 in all the rest of the world which do not come into the American association and even one of these may also be present in North America.

There are no known *Equiseta* in all the main part of the Pacific Ocean except those in the islands near the American continents and a single Asiatic species (*E. debile*) extending through the East Indies southeastward to the New Hebrides, New Caledonia, and Fiji Islands. There are none reported for New Zealand and Australia. Apparently there are none on the interior islands of the great expanse of the Indian Ocean, none in the South Atlantic, and none in Antarctica. In all the southern part of Africa there is but one species, the Eurasian *E. ramosissimum*. The northern part of Africa contains several European species. Several species extend around the earth in the north temperate zone and several species extend far into the Arctic. Two species (*E. hiemale* and *E. telmateia*) extend from western North America to western Europe, but are not found east of the Rocky Mountains, and apparently not in the great northern regions of Canada, and not in Greenland.

DISTRIBUTION OF THE SPECIES.

As stated in the introductory paleontological discussion, the modern species of *Equisetum* seem to have had their point of origin somewhere in the region of Central

America or in the northwestern part of South America, in a species which survived the general destruction which seemed to overwhelm the *Equisetales* toward the close of the Comanchean period. This surviving species or group at first gave rise to the present EQUISETA PRIMITIVA, to the two species, *E. xylochaetum* and *E. giganteum*. Three other species are frequently recognized, namely, *E. martii*, *E. schaffneri*, and *E. pyramidale*. At present these appear like mere ecological forms to the writer. They occur in the same general region with their two relatives and so the theoretical basis of our present geographic speculations will not be disturbed even if they are regarded as good species. These EQUISETA PRIMITIVA, in extending southward, did not give rise to new forms, or, if new species did appear beyond the equator in South America, they have all disappeared: so there is nothing in the south temperate zone to correspond to the interesting progression of species that one finds to the north. These species were shut off by the Pacific Ocean to the west and by the Atlantic to the east, so they neither reached the south sea islands nor southern Africa. The entire low-land basin of the Amazon also appears to be almost destitute of *Equiseta* of any kind except perhaps where there is high ground near the mountains. This is probably due to the intense competition which they would meet from the vigorous tropical Angiosperm vegetation of the Amazon basin. In South America then, the EQUISETA PRIMITIVA are found in the Andean region to central Chile and northern Argentina, in south central Brazil eastward into Minas Geraes, and Buenos Aires, and in the north they extend eastward through Venezuela. *E. giganteum* occurs northward on Haiti, some of the Lesser Antilles, Jamaica, the mountains of southern Cuba and in southern Mexico. Although there are some localities in Central America

where these *Equiseta* occur they are apparently rather rare, judging from the scarcity of published reports and representatives in herbaria. This scarcity is probably due to the fact that in Tertiary times all of Central America, northwestern Colombia, and some of southern Mexico was mostly under the ocean and the species have not been able to migrate back to the numerous favorable habitats that must be available for them in this region. *E. xylochaetum* seems to be confined to South America.

The land bridge is supposed to have been completed from California to Colombia during Comanchean time. Previous to the late Eocene it seems certain that Central America connected widely across the present Caribbean Sea to Jamaica and Haiti, which made it easy for the floras of both North and South America to spread into the Greater Antilles and, no doubt, accounts for the presence of *E. giganteum* in Jamaica, Cuba, and Haiti. The north-south tending Rocky Mountains cease in Mexico north of Tehuantepec and the Andes terminate in northwestern Colombia and eastern Panama. During Cenozoic time the volcanic mountains of Central America developed diagonally across the western ends of the east and west folds of the Caribbean configuration, but in the Oligocene, the Costa Rica-Panama land-bridge was almost everywhere covered by a shallow sea, as intimated above, thus again widely uniting the Caribbean Sea with the Pacific. In early Pliocene time there was also a short-lived marine portal extending across the Isthmus of Tehuantepec, but after this the whole of Central America emerged again and North and South America have remained connected ever since. These are the general conclusions of geologists and as will appear below the remarkable geologic movements indicated will help to explain several peculiar features of our present distribution of *Equisetum* species.

The EQUISETA HIBERNA are typically a temperate zone group, only two species being within the tropics. The lowest member, *E. myriochaetum*, occurs in southern Mexico. It is also reported from Ecuador, but this may be a mistake. Unfortunately, I have never seen material of this species but if the descriptions and illustrations of it are correct it is related on the one hand to *E. giganteum* and on the other to *E. ramosissimum* and *E. laevigatum*. It has the general appearance and characteristics of an EQUISETUM PRIMITIVUM but has the stomata in single rows. It is then the transition form between the tropical EQUISETA PRIMITIVA and the more advanced EQUISETA HIBERNA to the north. Both *E. laevigatum* and *E. praealtum* touch its territory in Mexico. Following *E. myriochaetum* are the two temperate zone species, *E. ramosissimum* and *E. laevigatum*, which are closely related forms. *E. ramosissimum* is in general the lower species. *E. laevigatum* extends from Mexico State northward through California to Washington and Alberta, eastward to Ontario, New York, Connecticut, New Jersey, Virginia, Kentucky, Arkansas, and Texas. It is the typical prairie *Equisetum*. *E. ramosissimum* extends from Japan through Asia and Europe and to Abyssinia, northern Africa, the Canaries, and the Azores. It is also found southward in Madagascar, Cape of Good Hope, Natal, and other regions of south Africa. It must have arrived in this region by migration southward from northern Africa. As stated, *E. ramosissimum* is apparently the more primitive of the two. We can assume that it originated in western North America, either directly from *E. myriochaetum* or perhaps more probably from an intermediate species, now extinct, from which *E. laevigatum* also arose in the western United States and thence migrated eastward as far as New England. The more reasonable supposition is probably that there was

an ancestral species in western North America, connecting on the one hand with Mexico and on the other with eastern Asia, and that this species early became extinct. Then *E. ramosissimum* can be derived in northeastern Asia whence it migrated westward and southward. In southeastern Asia, extending from India and Indo-China southward to Ceylon and eastward on the islands as far as Fiji, is *E. debile* which is very closely related to *E. ramosissimum* and can be derived directly from it on the margin of the latter's range in Southeastern Asia. Following *E. laevigatum* in North America is *E. praealtum* which has about the same general range as the former but spreading over a greater territory. It extends from Vera Cruz and Puebla States in Mexico northward to Louisiana, northern Florida, Nova Scotia, Quebec, and Great Slave Lake, and northwestward to California and British Columbia. It may extend further but these are authentic records based on examination of herbarium material. *E. praealtum* can be derived directly from *E. laevigatum* and the mutation or transition may have occurred anywhere within the common range of the two species. The last species of the EQUISETA HIBERNA is *E. hiemale*. This has a very peculiar distribution which it shares more or less with *E. telmateia* and a number of other plants of widely separated orders. *E. hiemale* extends from southern California and Utah northward along the Pacific and in the Rocky Mountains through Yellowstone and Glacial National Parks, across Alaska, Japan, Korea, northern Asia and Europe as far as the Pyrenees Mountains, the British Isles, and Iceland. It is apparently entirely absent in North America east of the Rocky Mountains and is also wanting in Greenland. It is closely related to *E. praealtum* and we can assume, on the one hand, that it was a direct offshoot from this species, originating in western North America at the

margin of the range of *E. praealtum*, and migrating westward until it reached Iceland; or on the other hand, it may not be directly related to *E. praealtum* but to the *E. ramosissimum—E. laevigatum* complex through an unrecognized European species. There are forms in Europe described as varieties of *E. hiemale* which have elongated, ampliated sheaths and irregular rows of tubercles and crossbands of silex on the ridges of the main stem. These may be a real connecting species between *E. ramosissimum* and *E. hiemale*. This is the more probable hypothesis. If *E. hiemale* was ever east of the Rocky Mountains or in Greenland in the past, it was eliminated by the ice of the glacial period. The reported specimens of *E. hiemale* in southwestern Greenland appear to be *E. trachyodon* which may have been transported by the Norsemen. *E. hiemale* might perhaps be in Arctic Canada but this not probable, since it appears to be absent around Great Slave Lake while *E. praealtum* is present.

The third section, EQUISETA AMBIGUA, has two species entirely North America in distribution. *E. kansanum* is closely related to *E. laevigatum* but it as well as its near relative, *E. funstoni*, has evolved the annual habit of the aerial shoot and eliminated the prominent point from the cone. The distribution of *E. kansanum* is much the same as *E. laevigatum* but is usually within the limits of the latter species, especially toward the east. It is the typical transition prairie and plains species. Its known range is from Ohio to Texas, to southern California, northward to North Dakota, Alberta, and British Columbia. There are therefore three prominent species peculiar to North America and in general covering the same territory, namely, *E. laevigatum*, *E. praealtum*, and *E. kansanum*. *E. funstoni* appears to be a direct derivative from *E. kansanum*, originating in the south-

western part of the range of the latter species. It extends from central California southward, presumably into Mexico, and is essentially a desert species.

The EQUISETA PUSILLA represent the extreme evolution of the series included in the first and second sections. There is still some controversy as to some of the species. As a group they extend around the earth toward the north of the north temperate zone and range far into the Arctic regions. *E. nelsoni* is a recently recognized species with a known range from New York through northern Ohio, Indiana, Illinois, Michigan, Wisconsin, northern Wyoming and northwestern Montana. Its actual distribution may be much wider. It appears as a very distant relative of *E. laevigatum* and may be derived from the ancestral form of that species, in temperate North America. There has been much controversy over the specific validity of *E. trachyodon*, it being mostly considered as a hybrid. However, there are forms going under varietal names of *E. hiemale* which seem to have their real affinity with *E. trachyodon*, and when all these are grouped together they make a respectable species of wide distribution in the northern part of the north temperate zone, extending from North America westward through to Europe, the British Isles, Iceland, and one station in southwestern Greenland. The writer has not been able to come to a final conclusion about the matter. If *E. trachyodon* is a good species it can be derived from the same stock as *E. nelsoni* and represents a parallel evolution in the EQUISETA PUSILLA with *E. hiemale*. It is supposed to be mostly sterile which might account for its comparative rarity. This partial sterility is however no trustworthy evidence of an immediate hybrid origin. *E. variegatum* is a circumpolar species extending southward to about the middle of the north temperate zone. It can be considered as a direct advance on *E. trachyodon*

or on the ancestor of this species. It might have originated anywhere around the circle in the northern part of the north temperate zone. *E. scirpoides* is another circumpolar species, covering much the same ground as *E. variegatum* but usually not attaining such extreme northern habitats, although it is found in Spitzbergen and central western Greenland. *E. scirpoides* represents the extreme advance of the species usually grouped under the subgenus *Hippochaete*. It is a decided, culmination type and probably originated directly from the ancestral type of *E. variegatum* somewhere in the northern part of the north temperate zone.

The EQUISETA AESTIVALIA represent the lower section of the *Euequiseta*. They show decided advance over the EQUISETA PRIMITIVA and cannot be derived from any of the three higher sections heretofore considered. They have stomata scattered in bands, are annual in their aerial parts and the cones are without a point. They must then be connected with the *xylochaetum-giganteum* type, but a considerable series of advancing steps have been taken to come even to the level of the lowest species. It is probable, therefore, that a series of intermediate species between *E. giganteum* and *E. fluviatile* existed formerly which evolved in the region between Central America and the northwestern United States and which early became extinct. In a rapidly progressive evolutionary series, the members in the ladder of ascent need not be considered ever to have reached any considerable distribution area. *E. fluviatile* then was the first successful stage in the progressive, orthogenetic series and if it originated in the western part of North America, it migrated rapidly to the east and to the west across the Alaskan Land Bridge through Asia to western Europe. It is mostly confined between the parallels of 40° and 65° north latitude, but in Europe at least it extends north-

ward even to the Arctic circle. In North America it is distributed from Newfoundland to Delaware, to southwestern Ohio, northern Iowa, western Wyoming, and Oregon; northward to Great Slave Lake and southern Alaska. *E. palustre* is a distinct advance on *E. fluviatile* and also extends around the earth in the northern part of the north temperate zone. Its southern limit is usually several hundred miles north of the southern limit of *E. fluviatile* and it extends northward about the same distance. It was probably derived directly from the ancestral species of *E. fluviatile*. *E. diffusum* is an isolated species in the region of Yunnan, China, and the Himalayas. It can be derived directly from *E. palustre* which is to the north of it. *E. bogotense* is the only species of *Equisetum* that exists in a region where it presumably ought not to be. It is a species that is also related to *E. palustre*. It is distributed from Chile through the Andes to Guatemala and is also in Venezuela and British Guiana. It is apparently rare in Central America. If we connect it with *E. palustre*, with which it seems to have the nearest affinity, we are compelled to postulate an intermediate species which in the earliest possible times was derived in western North America from *E. palustre* and which migrated southward toward Central America and there gave rise to the tropical *E. bogotense*. The parent, connecting species died out while *E. bogotense* migrated southward and eastward through the mountains until it reached Chile and British Guiana.

The EQUISETA HETEROPHYADICA are all plants of the northern hemisphere, extending from the central part of the north temperate zone northward, some species far north into the Arctic regions. They are plainly the most extreme species and were derived from the same source as the EQUISETA AESTIVALIA in some region of the north

temperate zone, presumably in North America. In a general way *E. silvaticum* is the lowest species, although it has some decided specializations. It is mostly confined between the parallels of 40° and 70° north latitude. It occurs in southern Greenland and thence westward through Canada, Alaska, Siberia, Europe and Great Britain. *E. pratense* covers about the same belt as *E. silvaticum*, but is considerably within the northern and southern limits of that species. It usually is quite a distance north of the 40th parallel. In eastern America *E. pratense* is usually at least one to two hundred miles north of the southern limit of *E. silvaticum*. To the north it crosses the Arctic circle in Europe, but in general it usually appears to confine itself to the temperate zone. It might have originated anywhere around the circle but probably from an extinct species in western North America, which was the common ancestor also of *E. silvaticum*. *E. telmateia* has in general the distribution of *E. hiemale*, but with narrower north and south boundaries. It extends from southern California northward along the Pacific states into British Columbia and appears again in Asia and through western Europe to the British Isles. In Europe it extends from Denmark south to Greece, Algeria and the Azores. In America it does not reach the Rocky Mountains to the east. If it ever extended eastward it was probably destroyed by the glacier. We can assume that it had its origin in the western part of the United States, from the same ancestral species or complex that gave rise to *E. silvaticum* and *E. pratense*, whence it migrated westward through Alaska and across Asia to the west of Europe.

The final species, *E. arvense*, has the widest distribution of any *Equisetum*. The ultimate steps in complexity resulted in a most efficient organism, and since it is the most complex in hereditary reaction we can confi-

dently assume that it was one of the latest species evolved. This successful condition is all the more remarkable when we remember that geologically it belongs to a dying phylum. The area of distribution, therefore, does not at all correspond to the theoretical age of the species when compared with such species as *E. giganteum* or *E. myriochaetum*. *E. debile*, *E. diffusum* and *E. funstoni* are probably also recent species and they have rather limited distribution areas. This may perhaps be accounted for by the fact that each of these species is more or less hemmed in by climatic and other barriers. In any event, it is evident that many conditions determine area of distribution besides age. In many cases at least, the age determines the extinction of the species. *E. arvense* has evolved an extreme degree of tolerance to widely diverse conditions of temperature and other ecological factors and is, moreover, very adaptable in its fluctuating response to environment. These facts probably explain its very wide distribution. In general it extends from about 30° north latitude to beyond 80° north latitude. It is found entirely around the outer margin of Greenland, is in Spitzbergen, northern Siberia and Bering Sea. At the south it reaches northern Africa, central China, and central Alabama. For the most part it is rare below the 35th parallel of north latitude. Its immediate ancestors have disappeared from the earth, so it stands side by side with *E. telmateia*, which is in certain respects even more extremely evolved than *E. arvense*.

The main evolutionary movement in *Equisetum*, in respect to climate, appears in general to have been from the tropics to the extreme Arctic regions. In only two cases does it appear that a present tropical species developed from an immediate temperate zone ancestor, namely, in the case of *E. debile* and *E. bogotense*. *E.*

ramosissimum, although mainly a temperate zone plant, grows through the tropics of Africa. It has the widest range in latitude of any species, from about 60° north to 30° south. In the general movement from the tropics to the Arctic, each important step forward fitted the plant better to endure lower and lower degrees of temperature, so that in traveling through Arctic lands, toward the north pole, several species of *Equisetum* are among the last plant companions to be left behind before moving upon the great ice pack of the Arctic Ocean.

This general review of the geographic distribution of the living species of *Equisetum*, although still imperfect and in some parts based on incomplete knowledge, shows that the present distribution is in almost perfect accord with the phylogenetic relationship, worked out from purely morphological and physiological data.

COLUMBUS, OHIO.

Some European Fern Finds

NELLIE C. KNAPPEN

Two recent trips in Europe gave an opportunity for fern hunting on the continent and in Southern England. In 1927, a week in the Dauphiné Alps near La Grave, and another in the High Pyrenees near Cauterets and Gavarnie were devoted to botanizing. However, incidental to general sight-seeing, many ferns were observed and better recalled for the historic association.

Near Nevers, on old walls grew maidenhair spleenwort,[1] wall rue, bladder fern, oak fern, and rosettes of ceterach, which looks like rickrack braid in rich green and cinnamon tones.

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[1] See page 113 for list of scientific names corresponding to the common names employed in the text.

The maidenhair spleenwort was different from ours, stiff and coarse. Later, in many places, were found small plants that readily dropped the tiny pinnae, leaving the denuded rachises like little wads of horse hair.

All through the moist regions of France, the great fronds of bracken are characteristic of the roadside woods, very unlike American bracken in outline.

La Grave, a tiny village opposite the lofty Meige with its many glaciers is at an elevation of nearly five thousand feet. From the underside of rocks in the glacial streams grew green spleenwort, the fronds washed by the swift water. This form had the pinnae distant, and rather uneven, resembling specimens collected in small caves in the cliffs above Smuggler's Notch, Vermont.

Bladder and oak fern grew amid the slide rock of the steep slopes, and on the rocky meadows, mingling with edelweiss. On densely wooded boulder-strewn slopes nearer the glaciers, green spleenwort formed minute rosettes with fronds an inch or two in length. Other ferns were beech fern, spinulose and male fern, the rare alpine bladder fern with deeply lacerated lobes, and the always lovely mountain bladder fern. There was a good deal of *Lycopodium Selago* here.

A pleasant memory of the wonderful medieval walled city of Carcassonne was the glimpse of polypody growing in an ancient Roman well, seen from above when walking on the inner wall. This was the first plant of this species seen and it is not as common as here. On the outer ramparts crowded rosettes of a charming spleenwort, apparently Petrarch's, grew, alas, just beyond reach. Venus's-hair was found on the moat wall where water trickled constantly.

The commonest fern throughout the dry regions of southern France was ceterach—hanging in dusty curls

from every shelving wayside rock. But as one drew near the Pyrenees ferns were again abundant. All the way up to Gavarnie by train, tram, and bus one longed to gather this wayside wealth.

In the famous Cirque with its hanging glaciers and slender waterfalls, again green spleenwort dabbled its fronds in the little streams. The rare alpine beech fern grew here with the oak and bladder ferns.

Climbing a steep switchback trail behind the inn, a bunch apparently of grass amidst gay rock flowers on a bit of pasture wall proved to be forked spleenwort, an exciting find at the end of a day crowded with new experiences.

Ascending the trail to the Porte d'Espagne, a seven thousand foot saddle, grand views, vivid flowers, rare birds made the walk memorable. The ferns were mostly confined to the torrent bed, but little clumps of forked spleenwort were on many dry rocks, and close to the top, growing with a tiny woodsia, were dwarf plants of holly fern, the four or five inch fronds a contrast indeed to this species in the British Columbia mountains.

Cauterets, a watering place at about three thousand feet elevation, was the center of many mountain trails. Near the town in a rocky woods the first black maidenhair spleenwort was seen. This triangular fern is leathery and blue green in color, with a decided silvery bloom. Before the spores ripen, the long slender white indusia give a charming herring-bone pattern to the back of the frond.

On the long climb to the Lac du Gaube, a jade green lake formed by the great Vignemale Glacier, the misery of a steady cold rain was somewhat alleviated by the many new ferns encountered. Before reaching the lake, in a region of unusual glacial action a dripping mossy

cliff yielded many treasures. With beech and oak fern grew the rare limestone polypody and the three bladder ferns, fragile, alpine and mountain, were intermingled. Plants of deer fern a few inches high were a contrast to the rank growth of this fern so common on the Pacific Northwest Coast. The rare alpine beech or lady fern grew here, and the mountain shield fern with its delightful fragrance. Several of the prickly shield ferns were found here and the only crested fern seen in Europe. On low rocks about the lake grew parsley fern, so much like the American rock brake, familiar from Lake Superior and the Western mountains. Comparison, however, shows the sterile fronds of the European fern to be triangular, thin in texture, and with deeply lacerated pinnae.

At Biarritz dark green glossy fronds of sea spleenwort tantalized by growing out of reach on a high sea wall. Not till two years later was this collected in Cornwall.

Motoring from Seville to Algeciras a fortunate momentary delay of the bus among groves of handsome cork oaks, gave a chance to see the bright green triangular fronds of the hare's-foot fern, *Davallia canariensis*, clinging to the ruddy bark by a broad scaly rhizome. At the Rock of Gibraltar Venus's-hair and fragrant lip fern were seen.

In 1929 an invitation to motor through Europe was eagerly accepted. With hosts who were interested in flowers frequent stops gave opportunities for further fern hunting. No more delightful fern region can be found than the English counties of Cornwall and Devon. The hedgerows along the famous lanes are green with many ferns—male and lady fern, European hay-scented, spinulose, the various prickly shield ferns, deer fern and Hart's tongue. In this soft climate many species grow

on the old stone buildings, while the sea caves give shelter to others; some find scant footing on the cliffs, and others share the moors with the heather.

The first sea spleenwort seen was well out of reach on the roof of a big sea cave at Mousehole near Penzance growing with Venus's-hair and other ferns. It was accessible at Tintagel, above the ruins of King Arthur's Castle, but so deeply imbedded in crannies that it was all but impossible to procure the rootstock. This fern is very leathery, and due to a twist into a different plane, pressing is difficult. Specimens are bleached in spots from the excess of salt.

The first lanceolate spleenwort found was in a graveyard at Gulval near Penzance. This fern somewhat resembles black maidenhair spleenwort, but is broadly lanceolate, not deltoid in outline, narrowing toward the base, the lower pairs of pinnae being decidedly shorter. It is thin in texture, of a wonderful emerald green, has small oval sori, and there are hair-like scales along the rachis. This grows to considerable size on moors and in the edge of the woods, but is often small on walls. Some plants found on dry exposed rocks were coriaceous and were so divided and so narrow as to closely resemble the smooth rock spleenwort.

At Cheddar Gorge the rare limestone polypody was found once more, and at Waverly Abbey near Dover were royal and marsh ferns. In Germany and Czecho-Slovakia forked spleenwort proved fairly common and in the Black Forest the ostrich fern was found.

In Central Austria near Mariazell, Alpenrose bloomed on the steep mountain sides, and the magenta flowers of wild Cyclamen sprang from beds of *Lycopodium Selago* and *Selaginella spinulosa*. Here was found the only Botrychium seen, Virginia grape fern, and moun-

tain bladder fern grew to an unusual size, one very finely cut frond measuring eight inches in height by eleven in width, with a stipe over ten inches long. This locality was memorable as well for the sight of four wild Chamoix that came very close before taking fright.

In Austria and in the German Tyrol the green spleenwort was abundant and of a beautiful type. The fronds are long, pinnae rather square, deeply and regularly crenate, and often lobed. Two plants had all the fronds dichotomously branched, recalling the Linnaean specific name, *Trichomanes-ramosum*.

Near the top of Furka ober Alp Pass in Switzerland, at about ten thousand feet altitude, stunted holly fern grew in a small rock cavern, the stemless fronds three or four inches long with closely imbricated pinnae, like the plants found in the high Pyrenees. With this grew one plant with eighteen inch fronds, the pinnae spaced, the lowermost half dozen pairs an inch or more apart, and reduced almost to scales, giving the effect of a long stipe, thus resembling the western American form. There were about the same number of pinnae—thirty-five or forty pairs on the fronds of the two plants.

In the Gorge de Triente in western Switzerland long fronds of Hart's tongue were in contrast to a finely cut, slender fern growing in the spray on the opposite wall to the one where the walk is suspended. Finally a few plants were discovered high up on the near side. These turned out to be the long desired smooth rock spleenwort, now seen for the first time. This fern is intriguing to Americans, due to its reported collection on two occasions in this country. The slender yet coriaceous, lacy fronds have an elongated S-shaped outline with the ultimate pinnules ending in curving spines.

Some European Ferns

At the Gorge de Chauderon at Montreux the steep walls were rank with great plants of Hart's tongue and an unusual maidenhair spleenwort with arching ten inch fronds. The Hart's tongue found in Europe had very thin fronds, except the stunted plants growing on walls in Devon and Cornwall. This fern in New York has more leathery fronds. In Brittany lanceolate and sea spleenwort were again seen.

Nearly forty species and subspecies of ferns were found on the two trips. Most of these have the same or a closely related species in our country. Of the asplen-iums, *ceterach*, *fontanum*, *marinum*, and *lanceolatum* are not known in America, and *A. adiantum-nigrum* has been collected but once. Of the shield ferns only *Dryopteris aemula* is wanting on this side of the Atlantic.

LIST OF FERNS COLLECTED

Botrychium virginianum	Grape Fern
Osmunda regalis	Royal Fern
Onoclea struthiopteris	Ostrich Fern
Pteridium aquilinum	Bracken
Allosorus crispus	Parsley Fern
Cheilanthes odora	Fragrant Lip Fern
Adiantum capillus-veneris	Venus's-hair Fern
Cystoperis fragilis	Bladder Fern
" *alpina*	Alpine Bladder Fern
" *montana*	Mountain Bladder Fern
Asplenium ceterach	Scaly Spleenwort
" *fontanum*	Smooth Rock Spleenwort
" *marinum*	Sea Spleenwort
" *trichomanes*	Maidenhair Spleenwort
" *viride*	Green Spleenwort
" *septentrionale*	Forked Spleenwort
" *adiantum-nigrum*	Black Maidenhair Spleenwort
" *lanceolatum*	Lanceolate Spleenwort
" *ruta-muraria*	Wall-rue
Athyrium filix-foemina	Lady Fern

Athyrium alpestre	Alpine Beech Fern
Polypodium vulgare	Common Polypody
Polystichum aculeatum	Hard Prickly Shield Fern
" *angulare*	Soft Prickly Shield Fern
" *lobatum*	
" *lonchitis*	Holly Fern
Dryopteris phegopteris	Beech Fern
" *linnaeana*	Oak Fern
" *robertiana*	Limestone Polypody
" *montana*	Mountain Fern
" *thelypteris*	Marsh Fern
" *filix-mas*	Male Fern
" *rigida*	
" *spinulosa*	Spinulose Shield Fern
" *dilatata*	
" *aemula*	Hay-scented Fern
Lomaria spicant	Deer Fern, Hard Fern
Phyllitis scolopendrium	Hart's Tongue
Davallia canariensis	Hare's-foot Fern

EXPLANATION OF PLATE

(Reading from left to right.)

1. *Asplenium marinum*, Tintagel, Cornwall, England. a. Upper side. b. Under side.
2. *Asplenium ceterach*, Nevers, France. a. Upper side. b. Under side with some scales removed to show fruiting.
3. *Asplenium fontanum*, Gorge de Triente, Switzerland. a. Upper side. b. Under side.
4. *Asplenium septentrionale*, near Bern Kastel, Germany. a. Under side. b. Upper side.
5. *Asplenium lanceolatum*, Logan Rock, Cornwall, England. a. Under side, rare type. b. Upper side, normal type, but unusually small.

WASHINGTON, D. C.

A New York State Fern Law

M. L. Overacker

For the past two years, with much preceding discussion, the Syracuse Botanical Club has been working on the problem of legal action to save at least one of the rare ferns, menaced by commercialism and auto-recreationists, for which our section is famous. Green Lake, east of Jamesville, was dowered by nature with a fern flora that made it a magnet for scientists and fern lovers the world over. Though the work of the Solvay Process Co., to which the fern-clad cliffs were only raw material for baking soda, this rare and beautiful station has been utterly destroyed.

Rarest of all was the hart's tongue fern, *Scolopendrium*, and some four or five hundred specimens of this were removed, with belated assistance from the Solvay Co., from certain destruction to a location nearby that we hope will be safe. The hart's tongue is found only in four or five spots in Onondaga and Madison counties, in Tennessee, in Ontario, and apparently in Guatemala, and in no other locality on this continent. Its appearance is so unlike the ordinary aspect of a fern that the average person might overlook it. The chief danger of extinction, aside from the destruction of its habitats, comes from students of botany who exchange plants, and from nurserymen who dig it up to sell.

The members of the Syracuse Botanical Club feel that they have at last done something practical by way of protection in getting the new amendment, protecting the hart's tongue, passed by the legislature. Miss L. W. Roberts, and other active members, but chiefly Mrs. John W. Church, Chairman of the Club Legislation Committee, have worked like beavers to build the protective dam. Assemblyman Horace M. Stone, aided by Assemblyman

W. H. Sargent, and Senator Fearon have capably engineered the amendment through the breakers. There were difficulties, for these devoted public servants had to take a terrible "razzing" from their colleagues for sponsoring so unpractical (?) a measure. At one time, it looked as if some earnest members of the Botanical Club would be called upon to go to Albany expressly to shed tears to aid in floating the amendment. There is a legend that the original conservation law was so put through the Legislature by a devoted gentleman and lover of nature.

Now that the possession of a whole or a part of a hart's tongue plant is legally a misdemeanor, and the Conservation Commissioner, state council of parks, state police, all peace officers, and every interested person are charged with enforcing the law, some *Scolopendrium* should be left for future generations. The Syracuse Botanical Club, which celebrated its fiftieth anniversary last year, feels this achievement a cheering start on its second half century of work. The Club has had the new law printed in card form for distribution through schools. It is reprinted below as a matter of record and information for others interested.

Amendment to New York State Conservation Law relative to the protection of certain plants, shrubs, trees and vines.

Sponsored by Syracuse Botanical Club and passed by State Legislature of 1930

"Malicious injury to the destruction of property:

2. A person who wilfully cuts down, girdles or otherwise injures or destroys, a fruit, shade or ornamental tree standing on the lands of another, or takes, picks, plucks, severs, carries away, removes or injures, in a manner to kill or cause to die, or destroys any plant, shrub, tree or vine or any wild or cultivated trailing arbutus (epigaea repens), flowering dogwood (cornus florida), mountain laurel (kalmia latifolia), any of the moccasin

flowers including cypripedium acaule, cypripedium pubescens, cypripedium parviflorum, cypripedium regina or either gentiana crinita or gentiana andrewsia or ferns of any kind growing on the lands of the people of the state or in any street, highway, public place or park belonging to or under the control of any county, city, town or village;
or

2–s. Who wilfully digs up, takes or carries away the heart's tongue fern (scolopendrium vulgare) from any location in Onondaga or Madison Counties, shall be guilty of a misdemeanor.''

The conservation commission and the state council of parks, within their respective juridiction, their several employees, the state police and all peace officers, are charged with the duty of enforcing this section.

Possession by any person of the whole or part of a plant which this section is intended to protect shall be presumptive evidence that the same was unlawfully taken by the possessor.

SYRACUSE, N. Y.

The Root-stocks of the Broad-leaf Spinulose Ferns

EDWARD H. CLARKSON

The root-stock of *Dryopteris dilatata* var. *americana* is apparently *always prostrate and creeping*. I have examined hundreds of these ferns in various parts of New England and have never found any exception to this.

Dryopteris dilatata, on the contrary, has an *ascending or upright root-stock* that, according to Thomas Moore is "*never creeping.*" Old root-stocks occasionally fall over and become decumbent (reclining and turned up at the growing end).

I quote from the following books and writers. In "Nature Printed British Ferns" (1863 ed.) Thomas Moore wrote of this fern: "Caudex stout, usually erect, rarely decumbent, not creeping, often becoming elongated and trunk-like, the fronds arranged in a circlet around the crown when erect." In "Ferns of Great

Britain and their Allies'' Anne Pratt describes the root-stock of *Lastrea dilatata* as follows: ''Its rhizome is often conspicuous above ground as it does not creep nor send out branches, but becomes a firm, strong base, rising erect like a stem, sometimes half a foot or a foot above the surface of the ground.'' Dr. C. Luerssen, in his ''Die Farne,'' 1889, gave the root-stock of this fern as ''thicker than in *spinulosum*, ascending or very often upright.'' According to Carl Christensen of the Botanical Museum, Copenhagen, Denmark, this fern in the latest handbook of the Scandinavian Flora (Hartman's Handbok i Skandinaviens Flora, ed. by Otto R. Holmgren, 1922) is described, under the name of *D. austriaca* (Jacq.) Woynar, as having a ''root-stock short and thick and nearly upright.''

To the above, I can add that all of the 48 root-stocks of *Dryopteris dilatata* imported by me from Scotland in 1923–1924 were absolutely upright. They were medium-sized to quite small.

In a previous article (''The Habitat and Distribution of the Broad-leaf Spinulose Ferns,'' AM. FERN JOURNAL, Vol. 18, no. 4, Nov. 1928) I showed how decidedly these two ferns differed in those two characters. It would seem very evident, therefore, that *D. dilatata* var. *americana* should be recognized as a species. As such, it is entitled to the name *Dryopteris* **campyloptera** (Kunze) Clarkson, n. comb., *Aspidium campylopterum* Kunze, Am. Journ. Sci. ser. 2, **6**: 84. 1848.

In an article published in Rhodora in Feby., 1915, Prof. M. L. Fernald says of this fern: ''the plant is close to *Dryopteris spinulosa*, and in our northern forests certainly grades into it. As a variety, however, it deserves recognition as *Dryopteris spinulosa* (Müll.) Kuntze, var. ***americana*** **(Fischer).''**

I consider it impossible for these two ferns to grade into each other for the following reason. The leaves of *Dryopteris campyloptera* are very susceptible to frost. A temperature of 32° F. or slightly less will soon kill them, causing them to curl up and turn brown. The sterile fronds of *Dryopteris spinulosa*, on the contrary, are evergreen, or at least semi-evergreen. They may be found plentifully in the spring after the snow has melted, green and fresh. Were *D. campyloptera* a variety of *D. spinulosa*, there certainly could not be any such great difference in the evergreen quality of their leaves. *D. campyloptera* is undoubtedly more closely related to *D. dilatata* than to any other fern.

NEWBURYPORT, MASSACHUSETTS.

Recent Fern Literature

Rock Garden and Alpine Plants; Henry Correvon. MacMillan Company. 1930.

This new book, entitled "Rock Garden and Alpine Plants," appears to be the first issue in English. The author, Henry Correvon, is a very prolific writer on horticultural subjects. One previous title has been translated into English, "The Alpine Flora." as well as into German. One other title was issued in Italian.

Mr. Leonard Barron writes an introduction to the present volume detailing his acquaintance with Mr. Correvon's writings on rock gardens, alpine plants, and other similar topics over a period of forty years. Mr. Correvon, in his preface, notes that his first book was published in 1884 and that he had begun a special interest in alpine plants some years earlier in 1877.

The book has some special interest to fern lovers through its inclusion of a chapter on the fernery, in which, in addition to a general discussion on the culture

of hardy ferns, he lists, alphabetically, some different species with which he has had experience in the garden. This number does not include the many additional hundreds of horticultural varieties of some of these species. A footnote regarding the vitality of a European rock fern is worth quoting in full: "Under such conditions the plant can resist drought for a long time. In my first book on Ferns, Les Fougères Rustiques, 1890, I record an instance of Ceterach officinarum retaining its vitality two years in an herbarium, and reviving after that period." Surely, that comment opens a very interesting field for inquiry and experimentation.

The comment on the European and some of our native species are particularly interesting. Our American Maidenhair comes in for a special appreciation. His comment on *Asplenium ebeneum* seems to be based on a misconception, for he says of it: "This is the *A. trichomanes* of North America but much more developed than the European type; . . ." The New York fern is included first under *Asplenium* and later under "*Nephrodium*" in connection with other shield ferns.

Despite such mistakes in detail, however, the book may be recommended for those interested in rock gardens. Its instructions for arranging rock walls in such a way as to serve for growing plants are of extremely practical value. In general, it is a book for a horticulturist and a gardener, the fern chapter being a relatively small portion of the whole book, most of which is taken up with a discussion of plants suitable for rockeries, arranged in alphabetical order.—R. C. B.

Mr. B. F. Bush has published a comprehensive fern flora of Oklahoma. A brief review of the collections and the records in literature of Oklahoma ferns is followed by an account of the topography and drainage systems

of the state, and of the five floristic provinces into which it may be divided. Then comes a list of fifty species known to occur in the state, with, under each, citation of specimens and critical notes. Names of species erroneously recorded and of species likely to be found in the state are also listed, but in different type and within parentheses, so that no confusion is likely to result. The final product is a thorough list, readily consulted and, since it is based on cited evidence, readily checked in case of doubt.[1]

Various small errors have crept into the text. Mr. Greene's article in vol. 17 of this JOURNAL is regularly cited as from the as yet non-existent vol. 27. Stevens no. 1799 was distributed as *Equisetum laevigatum*, not *E. variegatum*, as stated on p. 111. And the printer's devil must have been responsible for the statement on p. 97 that the cañons of western Oklahoma are "very attractive to Ferns, and several far western and southwestern species reach their northeastern limits there, such as *Woodsia oregana* and *W. scopulina*." The northeastern limit of both these species is in the Gaspé Peninsula in the Province of Quebec.

With two of Mr. Bush's comments the present reviewer is compelled to disagree. Under *Pellaea atropurpurea* he remarks: "Some of the specimens enumerated above are probably to be referred to *P. glabella* . . . especially those cited by Davenport, and those collected by Carleton and Stevens." *P. glabella* is a comparatively northern plant which one would expect to be much less common in Oklahoma than *P. atropurpurea*: and all of the five collections by Stevens in the Gray Herbarium belong to the latter species.

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[1] Bush, B. F. Ferns of Oklahoma. Am. Midland Nat. 12: 91–112. 1930.

Dryopteris Filix-mas is listed as having been collected at Kenton, Cimarron County, by Stevens (no. 497) and Mrs. Nice, but with the comment "surely not the real *Filix-mas*, as none of the authorities assign it anywhere near Cimarron County, Oklahoma. The specimens are too young to satisfactorily determine, and they possibly are *D. marginalis*." And on the strength of this, Stevens 497 is listed as *D. marginalis*.

This is a bold proceeding. No subject is more full of pitfalls than plant geography; to determine a specimen solely on one's idea of what the range of the species to which it is referred should be, one needs to be sure-footed indeed. In this case, Kenton is at the extreme western end of the Oklahoma Panhandle, not far from the border of New Mexico; Wooton & Standley (Cont. Nat. Herb. **19**: 25. 1915) record *D. Filix-mas* from five localities in that state, at least one of them nearer Kenton than the nearest recorded station for *D. marginalis*. To the present reviewer the western edge of the Panhandle would appear a natural enough locality for *D. Filix-mas*, but a distinctly unnatural one for the northeastern *D. marginalis*. Moreover, the specimen of Stevens 497 in the Gray Herbarium, though young, is by no means undeterminable; and it is "real Filix-mas," as that wide-ranging species is usually understood. The serratures of the pinnules are acute, not rounded as in *D. marginalis*; the immature sori are not marginal; and the indusia, which are fairly well developed, have glandular margins, a feature which, so far as I know, has not been found in *D. marginalis*, but does occur in certain forms of *D. Filix-mas*. It would seem that Mr. Bush's record of *D. marginalis* from Cimarron Co. should be stricken out, and Mr. Green's of *D. Filix-mas* should stand unquestioned.

Recent numbers of the *American Botanist* contain several notes on ferns. In vol. 35, pp. 99–102 (1929), Prof. Clute describes, discusses, and illustrates the form of walking fern with the basal lobes elongated and sometimes rooting like the apex, which, he states, is not uncommon in the Ohio Valley. He also gives it a name. It has been named twice before: once, not very seriously, by Prof. Clute in the *Fern Bulletin* (**15**: 87. 1907), and once formally by Mr. Hoffmann in his Flora of Berkshire County, Massachusetts (Proc. Boston Soc. Nat. Hist. **36**: 195. 1922). Happily the same formal or varietal name, *auriculatus*, was used in all three cases.—In vol. 35, pp. 152–156, an anonymous writer gives, under the title "The Fern's Place in Nature," an excellent brief account of the main characteristics of the pteridophytes.—Mr. J. G. Scott (**36**: 24–29. 1930) writes characteristically of the family fern, *Asplenium ebenoides*, which he is now inclined to regard as a form of *A. pinnatifidum*; and in the next number is duly corrected for imputing to Dr. Wherry opinions which that gentleman never held.—Mr. Plitt (**36**: 40–41) records an instance of *Asplenium platyneuron* growing as an epiphyte on the trunk of a red maple about five feet above the ground.

Mrs. Josephine F. Clark has reported interestingly on the ferns of the Red River Country, Maine.[2] This is in the northern part of Aroostook County, and it is a good place for ferns. Mrs. Clark has found typical *Botrychium lanceolatum*, not previously recorded from the eastern United States; *Woodsia alpina*, new to Maine; and *W. glabella* and *Thelypteris fragrans*, var. *Hookeriana*, each known from only two or three other stations in the state. In addition to these four rarities, she lists 25 other species.—C. A. W.

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[2] Rhodora **32**: 133–136. 1930.

CRESTED POLYPODY.—Ledgy hillsides have long been fascinating to us, and their allure is greater every year. One such location, in the town of Florence, Vermont, had attracted us as we drove home one day and early in October, 1929, we visited it. Separating as we reached the "hunting ground," one group turned south and soon were heard exclaiming over beautiful plants of Purple Cliff Brake and Maidenhair Spleenwort. The rest of the party searched along the ridge in a northerly direction and for a time it seemed a hopeless quest, for no ferns of any kind were to be seen. But, just as discouragement took possession of me, I saw in a crevice some fronds of the marginal fern and the bright green of Maidenhair Spleenwort. Going over to examine them, I saw also the dead fronds of Blunt-lobed Woodsia and both green and dead fronds of something else—something so startlingly curious I could hardly believe it, but after a time I assured myself I had found a crested Polypody. Search in the vicinity revealed no other ferns, but as we descended the ledges and made our way back by a different route, we saw many colonies of Walking Fern, beautiful plants of Maidenhair Spleenwort, a few plants of Purple Cliff Brake, and many withered plants of Blunt-lobed Woodsia, a few of them having green fronds, apparently new since the frost of a few days previous.

Our Polypody was taken to the photographer the next morning, then carefully set in the rock garden among other Polypodies which had there found comfortable abiding places. Later a photograph and pressed fronds were sent to Mr. Weatherby, who found they met in almost every particular the description given by B. D. Gilbert of his *Polypodium vulgare*, var. *Churchiae* (See *Fern Bulletin* **14**: 39, 1906). As no illustration of Gil-

Crested Polypody
(the small fronds are maidenhair spleenwort)

bert's plant was published, it is thought the likeness of our plant will be of interest to fern lovers.

It is a pleasure to record that the plant seems to have survived the winter in its new home, the green fronds looking as fresh now (April 23) as last October, and we await the coming of new fronds with much impatience. When found the plant bore three fresh green fronds—one so young its many divisions were not fully unfurled—three fronds beginning to show brown at their tips (these we considered to be fronds of the previous year) and very many old and dead fronds, but all showing the amazing peculiarities of stalked pinnae and many times divided rachises.—ELSIE M. KITTREDGE, *Woodstock, Vermont.*

American Fern Society
Report of the Treasurer for 1929

GENERAL FUND

RECEIVED

Cash on hand Jan. 1		$1,001.73
Membership dues 1927	$ 9.00	
1928	40.50	
1929	416.25	
1930	28.50	
1931	1.50	
	$495.75	
Subscriptions to Journal	96.78	
Emergency Fund, sale of Back Numbers of the Journal	151.26	
Reprints	28.95	
Illustrating Fund, gifts	2.41	
Special gift for Journal expense	8.88	
Advertising	4.00	
Interest	25.00	
1928 Protested Check paid	3.00	
Exchange	.20	
Total Amount Received	$816.23	816.23
		$1,817.96

PAID OUT

Editors' Account American Fern Journal

Printing			$275.00
Title-page, contents, Index, 6 and 8 pt.			26.69
Printing extra pages and insert			79.16
Illustrations			72.93
Mailing and postage			18.63
Stencils			2.88
Brooklyn Botanical Garden expense			1.04
Editor's postage and expense			6.08
Special appro. for purchase of Back numbers and other Fern literature			31.50
Total *Journal* Expense			513.91
Less credit from printer used 1930 of $6.92 leaves net Journal Expense of		$506.99	
Budget allowed	$469.50		
Illustrating Fund	28.61		
Special Gift	8.88		
		506.99	
Reprints (refunded)		$ 28.95	
Treasurer Expense		31.22	
Secretary Expense inc. Membership list		43.74	
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I would recommend the transfer of a portion of the Emergency Fund to the Special Reserve Fund.

Respectfully submitted,

JAY G. UNDERWOOD, *Treasurer.*

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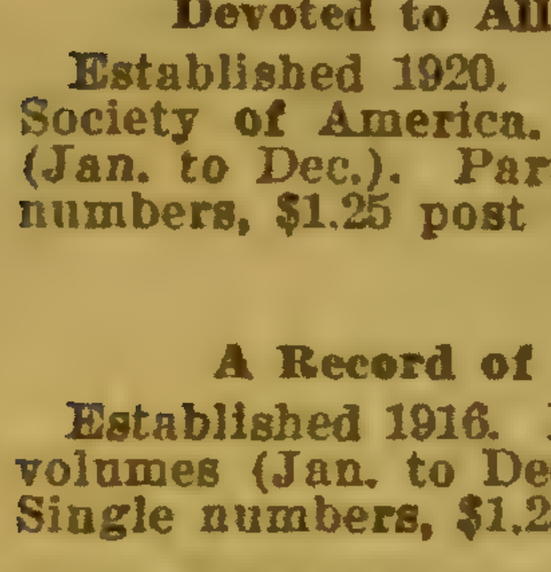

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Vol. 20 October-December, 1930 No. 4

American Fern Journal

A QUARTERLY DEVOTED TO FERNS

Published by the

AMERICAN FERN SOCIETY

EDITORS

R. C. BENEDICT

E. J. WINSLOW C. A. WEATHERBY

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American Fern Journal

VOL. 20 OCTOBER–DECEMBER, 1930 NO. 4

Has the Genus Onychium any Representative in South America

DR. J. B. KÜMMERLE

According to the present status of our knowledge, as represented e. g. in the excellent book of Christensen[1], there are four species of the small tropical genus *Onychium* from Asia (*O. siliculosum, japonicum, tenue, cryptogrammoides*), one common to Asia and Africa (*O. melanolepis*), and one (*O. strictum*) endemic in the West Indies. *Onychium strictum* is therefore the only American species of this genus, and has not been found, so far, on the continent. The genus has no representative—so far as is known in the latest literature—in South America.

While determining some very old fern collections in the Botanical Department of the Hungarian National Museum at Budapest, I came across a specimen, no. 8, collected in Peru, but without the name of the collector, and determined as belonging to the genus *Pteris*. To my great surprise, I recognized in it the genus *Onychium* from South America, and found it entirely corresponding to the diagnosis of *Pteris siliculosa*, published by Desvaux in 1811, based on specimens from "South America." In 1827 the genus *Phorolobus* was created by Desvaux, to which he transferred the new *Pteris siliculosa* together with some other, very heterogeneous, spe-

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[1] Index Filicum, p. 468 (1906) and Suppl. I, p. 53 (1913).

[Volume 20, No. 3 of the JOURNAL, pages 89–128, plates 5 and 6, was issued October 12, 1930.]

cies, e. g. *Cryptogramma crispa, Pteris ensiformis, Neurosoria pteroides.* The species name of Desvaux is used later by Prof. Christensen in the Index Filicum in the combination *Onychium siliculosum* (Desv.) Christensen; there are added as synonyms the following names; *Acrostichum viviparum* Cav., *Onychium auratum* Kaulf., and *Pteris chrysocarpa* Hook. et Grev., and tropical Asia is given as the only native place of the species. I am strongly convinced that the Peruvian fern of our Herbarium belongs to the very same collection met with by Desvaux; in consequence our specimen is a cotype. Comparing the Peruvian fern with the original specimen of *Onychium auratum* Kaulfs. from Manila (collected by *Chamisso*) in possession of the Botanical Department of the Hungarian National Museum, it was very easily seen that the two were identical. The peculiar occurrence of the Malayan fern in Peru, without any records from places between Eastern Asia and South America might raise some doubts, if similar cases were not already known for ferns—e. g. *Cryptogramma crispa* (L.) R. Br., of Europe and Eastern Asia, is cited from Chile (as *Pellaea fumariaefolia* Phil., teste Christ in Christensen Ind. Fil. p. 187). The theory of Wegener,[2] according to whom the continents first belonging together were driven off later from each other, may give an explanation for the occurrence of our fern in two remote localities.

Based on comparison with some original specimens (*O. auratum, siliculosum, tenue, cryptogrammoides*), I find the following species in the genus: 1. *Onychium aureum*

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[2] Die Entstehung der Kontinente und Ozeane. 1 Aufl. 1915. 3 Aufl. 1922. Also see E. Irmscher, Pflanzenverbreitung und Entwicklung der Kontinente. Studien zur genetischen Pflanzengeographie (Mitteilungen aus dem Institut für allgemeine Botanik in Hamburg. V. 1922).

(Wall.) Küm.; 2. *O. viviparum* (Cav.) Küm.; 3. *O. melanolepis* (Decne.) Kze.; 4. *O. japonicum* (Thbg.) Kze.; 5. *O. strictum* Kze. My investigations were made on material from the Herbarium of the Hungarian National Museum (Budapest). Grateful acknowledgment is due to Prof. Dr. H. Lecomte (Paris) for an original specimen of Christ, to Director Dr. K. Keissler (Vienna) and to Professor Dr. Fr. Markgraf (Berlin) for original diagnoses kindly secured for me.

SYNOPIS OF THE SPECIES OF ONYCHIUM

SECTION 1. EUONYCHIUM Kümm. Indusium apparently marginal; sori coated with waxy powder.

a. *Sori golden-yellow; indusium yellow.*

1. ONYCHIUM **aureum** (Wall.) Kümm., n. comb.

1828. *Lomaria aurea* Wall. List, no. 38. Nom. nud.
1828. *L. caruifolia* (recte carvifolia) Wall. l. c. no. 39.
1829. *Pteris chrysocarpa* Hook. et Grev. Icon. Fil. pag. ad tab. CVII. Diagnosis; *Lomaria aurea* Wall. cited as synonym.
1829. *Pteris chrysosperma* Hook. et Grev. l. c. tab. CVII.

ILLUSTRATIONS: Hook. et Grev. l. c. tab. CVII (very good); Beddome, Ferns so. India (1873), tab. XXX. Handb. Ferns Brit. India (1883) tab. 49.

TYPE LOCALITY: Nepal leg. *Wallich* sub *Lomaria aurea.*

DISTRIBUTION: North India (Himalaya); Southern India?

b. *Sori pale yellow; indusium whitish.*

2. O. **viviparum** (Cav.) Kümm., n. comb.

1802. *Acrostichum viviparum* Cav. Descr. Pl. p. 240.
1811. *Pteris siliculosa* Desv. Observations sur quelques nouveaux genres de fougères in Berl. Mag. V. p. 324.
1824. ***O. auratum*** **Klf. Enum. Fil. p. 144.**
1827. *Phorolobus siliculosus* Desv. Prodrome de la famille des fougères in Mém. Soc. Linn. Paris VI. p. 291.
1836. *Allosorus auratus* Pr. Tent. Pterid. p. 152.

Onychium viviparum (Cav.) Kümm.

1837. *Caenopteris quadripinnata* Blanco, Fl. Filip. p. 833.
1850–52. *O. carvifolium* Fée, Gen. Fil. p. 132, non *Lomaria caruifolia* Wall.
1856. *Pteris aurata* Mett. Fil. Hort. Lips. p. 54.
1882. *Cryptogramme aurata* Prantl. Die Farngattungen Cryptogramme and Pellaea in Engler, Bot. Jahrb. III. p. 413.
1901. *O. tenue* Christ, Reliquiae Weinlandianae in Bull. Herb. Boiss. ser. 2, I. p. 451.

ILLUSTRATION. Fée, Gen. Fil. (1850–52) tab. VII, G; tab. LV, fig. 1.

TYPE LOCALITIES: Philippines (Sorsogon), leg. *Don Luis Née* apud Cavanilles sub *Acrosticho viviparo;* Manila, leg. *Chamisso* sub *Onychio aurato* Klf. (type in Herb. Hungar. Nat. Mus.); New Guinea, leg. *Weinland* sub *O. tenue* Christ; Peru, (cotype in Herb. Hungar. Nat. Mus. under no. 8).

DISTRIBUTION: From Indo-China (Harroi, leg. *Eberhardt* under no. 8, determined as O. tenue by Christ; type in Herb. Mus. Paris), through Java and the Philippines to New Guinea and eastward to Peru.

This species is in cultivation; rare!

SECTION 2. CRYPTOGRAMMOPSIS Kümm. Indusium manifestly submarginal; sori not coated with waxy powder.

a. *Sori occupying the whole margin of the ultimate segments.*

3. O. MELANOLEPIS (Dene.) Kze. Farnkr. II (1848) p. 9.

1814. *Cheilanthes leptophylla* R. Br. in H. Salt, Voy. Abyss., App. IV. LXV. Nom. nud.
1841. *Allosorus melanolepis* Dene. Plantes de l'Arabie in Arch. Mus. Paris II. p. 189.
1847. *Allosorus cuspidatus* Hochst. apud Jaubert et Spach, Ill. Pl. Or. fasc. 21. III. p. 1.
1865. *Pteris melanolepis* Ettingsh. Farnkr. p. 88.
1882. *Cryptogramme melanolepis* Prantl, l. c. p. 413.

ILLUSTRATIONS: Kunze, l. c. tab. CIV, fig. 2 (very good); Jaubert et Spach, l. c. tab. 201 (very good); Et-

tingsh. l. c. fig. 39; Hooker, Icon. Pl. X. (1854), tab. 902 (good); Christ, Farnkr. Erd. (1897), fig. 458 (good).

TYPE LOCALITIES: Abyssinia, leg. *Salt* sub *Cheilanthide leptophylla;* Arabia, leg. *Paul-Emile Botta* sub *Allosoro melanolepe;* Persian Gulf, Island of Kareh, leg. *Kotschy* nos. 10 et 198 sub *Allosoro cuspidato.*

DISTRIBUTION: From Abyssinia, Nubia, and Eritrea through Arabia and the Sinai Peninsula to South Persia and the East Indies.[3]

b. *Sori occupying less than the whole margin, or only the middle on each side of the ultimate segments.*

a. *The segments mucronate at the apex.*

4. O. JAPONICUM (Thbg.) Kze. Pteridographia Japonica in Bot. Zeit. VI (1848) p. 507.

1784. *Trichomanes japonicum* Thbg. Fl. Japon. p. 340.
1794. *Caenopteris japonica* Thbg. Trans. Linn. Soc. p. 341 and Descriptio Caenopteridis in Nov. Act. Acad. Petrop. IX (1795). p. 161; Juel, Pl. Thunb. p. 59 (1918).
1810. *Darea japonica* Willd. Sp. Pl. V. p. 302.
1824. *Onychium capense* Klf. Enum. Fil. p. 145. (Cited by Kaulfuss from South Africa, probably in error. See Schlechtendal, Adumbr. p. 40 (1827); Kunze, Acotyledonearum Africae australioris recensio in Linnaea X (1836). p. 504; Hooker, Spec. Fil. II (1851). p. 122–123).
1836. *Allosorus capensis* Pr. Tent. Pterid. p. 152.
1845. *Asplenium japonicum* Kze. Ind. Sem. Hort. Lips., non Thbg.
1847. *A. Swartzianum* Kze. Linnaea XIX. p. 404.
1856. *Pteris japonica* Mett. Fil. Hort. Lips. p. 54.
1882. *Cryptogramme japonica* Prantl, l. c. p. 413.

ILLUSTRATIONS: Thunberg in Nov. Act. Acad. Petrop. IX, tab. G, fig. 2 (not seen); Kaulfuss, l. c. tab. 1. fig. 8 (very good); Hooker, Gen. Fil. (1842), tab. XI (very good); Fée, Gen. Fil. (1850–52) tab. VIII G, LV, fig. 2;

[3] See Kümmerle, Über das Vorkommen des Onychium melanolepis in Vorderindien in Folia Cryptogrammica I, no. 7 (1930).

Diels apud Engler-Prantl, Nat. Pflanzf. I. 4 (1899), fig. 148 E (very good).

TYPE LOCALITY: Japan, leg. *Thunberg*.

DISTRIBUTION: From North India (Himalaya) eastward through China and Korea to Japan, and southward to Java, Timor, and the Philippines.

This species is in cultivation; common.

SYNOPSIS OF VARIETIES.

†*Fronds uniform, the fertile segments siliquiform and acuminate at the apex.*

△ *Sori long,* 1–4 *mm.*

o *Frond lax, rather coarsely cut.*

Var. INTERMEDIUM Clarke, A Review of the ferns of Northern India in Trans. Linn. Soc. Bot. ser. 2, I. p. 459 (1880); Beddome, Handb. Ferns Brit. India p. 96 (1883).

ILLUSTRATIONS: Beddome, Ferns Brit. India, tab. 21 (1865). (not seen).

TYPE LOCALITY: Kumaon, Sikkim.

o o *Frond very finely cut.*

Var. LUCIDUM (Ham.) Christ, Les collections de fougères de la Chine au Museum d'histoire naturelle de Paris in Bull. Soc. Bot. France 58 Mém. I. p. 60 (1905); Christensen, Plantae Sinenses. Pteridophyta in Meddel. Göteborgs Bot. Tradg. I p. 92 (1924); Handel-Mazzetti, Symbolae Sinicae VI. Pteridophyta p. 37 (1929).

1825. *Leptostegia lucida* Don, Prod. Fl. Nepal. p. 14.
1825. *Scolopendrium lucidum* Hamilt. apud Don, l. c.
1827. *Onychium lucidum* Spreng. Syst. Veg. IV. p. 66.
1828. ***Cheilanthes lucida*** **Wall. List, no. 69.**
1828. ***Cheilanthes contigua*** **Wall. l. c. no. 72, secundum Clarke, l. c. p. 459.**
1880. *O. multisectum* Henderson apud Clarke l. c. p. 459.
1880. *O. japonicum*, var. *multisecta* Clarke, l. c.
1901. *O. contiguum* Hope, The Ferns of North-Western India in **Journ. Bombay Nat. Hist. Soc. XIII. p. 444.**
1909. *O. cryptogrammoides* Christ, Filices novae chinenses in **Notul. Syst. I, p. 52.**

Onychium japonicum (Thbg.) Kze., var. lucidum (Ham.) Christ.

ILLUSTRATION: see our figure 8.

TYPE LOCALITIES: Nepal, leg. *Hamilton* sub *Scolopendrio lucido*; Yunnan, Kiao Kia, leg. A. *Tchen et Ducloux* sub *Onychio cryptogrammoide* Christ in Herb. Mus. Paris.

DISTRIBUTION: from Himalaya to China.

ΔΔ *Sori short, only 1 mm.*

Var. PARVISORUM R. Bonaparte, Notes Ptérid. XIV. p. 80 (1923).

TYPE LOCALITY: Yunnan, leg. *Maire* in Herb. Bonaparte in Herb. Mus. Paris.

†† *Fronds dimorphous, the fertile segments linear-lanceolate and acute at the apex.*

Var. DELAVAYI Christ, Bull. Soc. Bot. France 52. Mém. I. p. 60 (1905).

TYPE LOCALITY: Yunnan, leg. *Delavay* no. 1715 in Herb. Mus. Paris.

β *The segments not mucronate at the apex.*

5. O. STRICTUM Kze. Farnkr. II. p. 11 (1848).

1857. *O. multifidum* Fée, 8 Mém. Foug. p. 74.

1883. *Cryptogramme stricta* Prantl apud Salom. Nomencl. p. 141.

TYPE LOCALITY: Cuba, leg. *Linden* sub *O. stricto* Kze. et *O. multifido* Fée.

DISTRIBUTION: Cuba, Porto Rico, Hispaniola.

DOUBTFUL SPECIES.

Onychium chinense Fée, Gen. Fil. p. 132 (1850–52), is probably identical with *Phorolobus chinensis* Desv. Prod. p. 291 (18–27), which is *Pteris ensiformis* Burm.

Don's *Lomaria decomposita*[4] Prod. Fl. Nepal. p. 14 (1825) does not belong with the genus Onychium, because he does not mention the remarkable "golden-yellow" color of the fructifications. As a synonym is given by Don *Pteris angustifolia* Hamilt. and only "Nepal" is cited. Probably Fée's *Lomariobotrys decomposita* (Genera, p. 46. 1850–52) is also identical with Don's fern. Clarke attributes it (in Trans. Linn. Soc. Bot. ser. 2. I.

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[4] See Hooker et Greville Icon. Fil. ad tab. CVII (1829) and Hooker Sp. Fil. II. p. 121 (1844).

p. 458. 1880) to *Onychium auratum* and Prof. Christensen to ? *O. japonicum*. I have not seen the type.

O. micropterum Hook. Gen. Fil. ad tab.XI. 1838. (Syn. *Lomaria microptera* Br. apud Hook. l. c., Sp. Fil. I. p. 124).

BUDAPEST.

Additional Notes on Texas Ferns

ERNEST J. PALMER

In the early part of the summer of 1928 I had another opportunity to visit the Davis Mountains of Southwestern Texas and also to extend my explorations into the Chisos Mountains, near the Mexican border. Since I was able on this trip to get into several cañons in the Davis group which I had not previously explored, I succeeded in adding a number of interesting plants to my earlier collections, including a few Pteridophytes not reported in the list published in the FERN JOURNAL, Vol. 17, no. 3, 1927. One of the ferns, *Polypodium erythrolepis*, proved to be a rare and little known species which had not previously been found in the United States, and so a brief account of its discovery and the locality where it was found may be of interest; and in order to make the list from this unusual locality as complete as possible the following species may be added to those previously reported:

Equisetum laevigatum A. Br.? Growing on moist sandy and gravelly banks of perennial stream, Little Ajuga Cañon, altitude about 1800 meters. No. 34258, June 12, 1928. The specimens found were all sterile, so the identification is subject to possible revision, but from the vegetative characters they appear to belong to this species.

Adiantum modestum Underwood. This species of Maiden-hair Fern, which is closely related to the widely distributed *A. Capillus-Veneris*, if indeed the two are

really distinct, is found along wet banks of perennial streams in the lower cañons. I did not collect specimens in the Davis Mountains, but saw plants that had been brought in from "Fern Cañon," near Ft. Davis.

Woodsia obtusa (Spreng.) Torrey. Growing under protecting ledges of porphyritic rocks, upper Madera Cañon, north of Mount Livermore, altitude about 2200 meters. No. 34285, June 1, 1928.

Cheilanthes alabamensis (Buckley) Kuntze. Found along low porphyritic cliffs and on partially shaded boulders, Little Ajuga Cañon, at an altitude of about 1700 meters. No. 34522, June 12, 1928.

Polypodium erythrolepis Weatherby. Growing on the face of a low cliff of igneous rock along one of the upper branches of Limpia Cañon, near Mount Livermore, altitude about 2100 meters. No. 34378, June 6, 1928.

The cliff upon which this little fern was found growing is only five or six meters in height and fifteen or sixteen meters in length. The exposure is to the south and east, thus affording protection from the hot afternoon sun, and it is also partially shaded on the other side, except for a few hours each day, by trees growing along the mountain ravine, which carries flowing water only during part of the year. The fern colony covers several square meters of the cliff face, the fronds arising from the extensive creeping rootstock, much as in the common Polypody. The fronds are narrowly ovate-spatulate, with rounded apices and tapering bases. They measure 1.5–3 cm. in width and 7–9 cm. long. The texture is coriaceous; the under surface is thickly covered with ferruginous scales; and there are usually two rows of large circular sporangia, although many of the fronds found were sterile.

The summer of 1928 was an exceptionally dry one, and at the time when they were found the fronds had already

fruited and were curled up and quite dry. The texture was so tough and leathery, however, that by wrapping them in wet burlap over night I was able to press some of them out and make fairly good herbarium specimens of them.

This fern appears to be quite rare and local in the Davis Mountains, as it was seen only at the one locality. It was previously known only from a few localities in Chihuahua and Sonora, Mexico.

The Chisos Mountains, where I spent a few days earlier in the season, constitute a small but well marked group, located in the Great Bend of the Rio Grande, close to the Mexican boundary. The mountains are of igneous origin, having been pushed up through the calcareous and sandy plain, from which they arise rather abruptly. The peaks and ridges are closely aggregated, many of them being high and precipitous and separated from each other only by narrow valleys and deep cañons. The main group covers an area of perhaps slightly less than one hundred square miles. Altitudes above sea-level are slightly less than in parts of the Davis Mountains, but since the surrounding country is some 2000 feet (600 meters) lower, with minimum elevations of 3000 feet on the north and 2000 feet in the Rio Grande valley, many of the peaks are actually higher and the country is much more rugged. The altitude of Lost Mine Peak, as determined by the United States government survey, is 7550 feet (2300 meters) and that of Mount Emory is 7853 feet (nearly 2400 meters). The rocks forming the mountains are largely rhyolite, diabase, diorite, lava and other igneous and crystalline varieties, and the soil resulting from their decomposition is generally somewhat acid. The rainfall is considerably less than in the Davis Mountains, and both winter and summer temperatures must range considerably higher.

Springs are found in some of the cañons, but most of them cease to flow in the dry months, and water is everywhere scarce.

In consequence of these conditions the vegetation is generally sparse in open situations and such plants as are found there are adapted to xerophytic conditions. Most of the trees and shrubs are confined to the deeper protected cañons, and it is only in such places and about springs that there is anything like an abundant growth of herbaceous plants, including most of the ferns.

The fern flora of the Chisos Mountains is quite similar to that of the Davis Mountains, but the number of species seems to be considerably smaller and most of those found are individually less abundant, as a result of the less favorable ecological conditions.

Owing to limited time and the difficulty of travel, I was able to explore only a limited part of the area, and it is quite probable that a more thorough investigation might result in adding other species to the following list:

Adiantum modestum Underwood. Locally abundant along the banks of a small mountain brook, Oak Cañon. No. 34122, May 25, 1928.

Pellaea intermedia Mettenius var. *pubescens* Mettenius. Rather frequent on slopes and ledges along sides of cañons. Juniper Cañon. No. 34078, May 22, 1928.

Pellaea Wrightiana Hooker. Growing under protecting ledges and about the bases of large porphyritic boulders in most of the cañons. No. 34131, May 25, 1928, collected in Oak Cañon.

Pellaea atropurpurea (L.) Link. Apparently rare, along ledges and clefts of porphyritic rocks. Boot Spring. No. 34186, May 25, 1928.

Cheilanthes Feei Moore. In clefts along face of cliffs, Boot Spring. No. 34187, May 25, 1928.

Cheilanthes tomentosa Link. This is one of the more abundant species, found along ledges and steep slopes

along the cañon walls. Nos. 34085 and 34087, May 25, 1928, Oak Cañon.

Cheilanthes Eatoni Baker. Uncommon in clefts and along ledges of cañon walls. No. 34104, Juniper Cañon, May 23, 1928.

Cheilanthes Lindheimeri Hooker. Frequent along ledges of cañon walls. No. 34123, Oak Cañon, May 24, 1928. No. 34166, near Boot Spring, May 25, 1928.

Cheilanthes alabamensis (Buckley) Kuntze. Uncommon in clefts and ledges of rocks about Boot Spring. Nos. 34134 and 34147, May 25, 1928.

Notholaena bonariensis (Willd.) C. Chr. Frequent along ledges of bluffs and about large porphyritic boulders. Nos. 34110, Juniper Cañon, May 23, 1928.

Notholaena Standleyi Maxon. Frequent on rocky slopes and sides of cañons. No. 34105, Juniper Cañon, May 23, 1928. No. 34151, Oak Cañon, May 24, 1928. This is *Notholaena Hookeri* of the Davis Mountain list.

Notholaena sinuata Kaulfuss. Abundant along ledges of cliffs and cañon sides. No. 34100, Juniper Cañon, May 23, 1928.

Notholaena sinuata var. *integerrima* Hooker. This appears to be one of the commonest or at least one of the most widely distributed ferns of the Chisos Mountain region, although it was not seen at the higher elevations. It is usually found growing amongst rubble on the lower slopes of the mountains and along cañon sides. Collected at Laguna, or Green Gulch, as named on the topographic sheet of the United States Geological Survey. No. 34167, May 25, 1928.

Asplenium resiliens Kunze. Apparently rare and local. Collected from clefts of rock about pool at Boot Spring. No. 34183, May 25, 1928.

ARNOLD ARBORETUM.

A List of Tennessee Ferns

BY W. A. ANDERSON, JR.

In the years 1927 to 1929 I was connected with the University of Tennessee, at Knoxville, during which time I gave considerable attention to the ferns of the region. Knoxville is very advantageously located for botanical exploration, as it is within easy driving distance both of the Alleghany and Cumberland mountains, besides having good collecting places in the immediate vicinity.

The collections of Gattinger and others, in the University of Tennessee herbarium, were available to me for study.

In 1929 I published, in the University of Tennessee Extension Series, a manual of Tennessee ferns, designed especially for use by persons without botanical training. This manual included all the species I had seen in the field and in collections.

I have since had the opportunity of examining the Tennessee collections in the Gray Herbarium, and thereby added several new records to the fern flora of the state. The specimens cited here do not represent nearly all the material examined, but do represent the distribution of each species within the state. The stations are arranged in each list geographically from east to west. County names are given except where the station is near a city.

Practically all of my own collecting was done in East Tennessee, that is, in the valley of east Tennessee around Knoxville, in the Great Smoky Mountains to the east, and in the Cumberland mountains to the west. This part of the state has the richest fern flora, as there is a greater diversity of soil and elevation than in other sections.

Between the Cumberland Mountains and the Tennessee River to the west is a rolling country, mostly of calcareous soil, known locally as Middle Tennessee. One part of it, the "cedar barrens" around Lavergne, supports a flora in which there is considerable endemism. Gattinger did most of his collecting in Middle Tennessee. H. K. Svenson made an important collection in this region in 1922.

West Tennessee is the part of the State that lies between the Tennessee and Mississippi Rivers. S. M. Bain, of the University of Tennessee, made collecting trips into that region in 1892 and some years following. More recent collectors are E. J. Palmer, who was there in 1920, and Svenson, in 1922.

I have listed each species under its most acceptable name, and where the name differs from that used in Gray's Manual, 7th ed., I have given synonyms. (See Weatherby, 1919; Fernald, 1922, 1928, 1929).

TRICHOMANES BOSCHIANUM Sturm

Although the filmy fern has a fairly wide distribution in Kentucky, Tennessee and Alabama, it is so selective of its habitat that it is rarely found. Apparently, it is confined to the Cumberlands, and westward into the Mammoth Cave region in Kentucky. I have seen no records of its occurrence in the Alleghanies. The Tennessee station is in the southern part of the state, in the edge of the Cumberland Mountains.

Sewanee, near Dr. Smith's, Franklin County, August, 1878, **Gattinger.**

WOODSIA OBTUSA (Spreng.) Torr.

Widely distributed over the state but nowhere abundant.

Johnson County, July 8, 1880, John Donnell Smith.
Tennessee River, Knoxville, June 11, 1893, Kearney.
Wolf Creek, Cocke County, Aug., 1881, Gattinger.
Foot of sandstone cliff, Ozone, Cumberland County, July 14, 1929, **Anderson, 1385.**
Near Nashville, July 8, 1922, Svenson, 67.
Henderson, Chester County, June, 1892, Bain.

CYSTOPTERIS BULBIFERA (L.) Bernh.

Johnson County, July 8, 1880, John Donnell Smith.
Cherokee Bluffs, Knoxville, Sept. 18, 1928, Anderson, 1103.
Cowan, Franklin County, Aug. 13, 1886, Gattinger.
Bluffs on Richland Creek, near Nashville, Oct. 6, 1885, Gattinger.
Kingston Springs, Cheatham County, Aug. 20, 1922, Svenson, 279.
Erin, Houston County, May 24, 1920, Palmer, 17608.

CYSTOPTERIS FRAGILIS (L.) Bernh.

Abundant throughout East Tennessee.
By spring, Tipton's Sugar Cove, Cades Cove, Blount County, **June 14, 1928, Anderson, 981.**
Roaring Fork, Gatlinburg, Sevier County, June 10, 1928, Anderson, 946.
Bluffs near Knoxville, Oct. 11, 1927, Anderson, 696.
Ocoee River, Polk County, ————, Gattinger.
Cleveland, Bradley County, Sept., 1879, Gattinger.
Nashville, ———— 1876, Gattinger.
Huntingdon, Carroll County, July, 1892, Scribner.

ONOCLEA SENSIBILIS L.

Fountain City, Knox County, Aug. 29, 1891, Kearney.
Wartrace, Bedford County, Sept., 1877, Gattinger.
Hollow Rock Junction (now Bruceton), Carroll County, Aug. 27, 1922, **Svenson, 414.**

THELYPTERIS PALUSTRIS (Salisb.) Schott, var. PUBESCENS (Lawson) Fernald.

Syn. *Aspidium thelypteris* (L.) Sw., *Dryopteris thelypteris* (L.) Gray.

Gattinger probably saw this species, but if he collected it, he did not keep a specimen. It is listed in his Flora of Tennessee.

Kingston Springs, Cheatham County, Aug. 20, 1922, Svenson, 269.

THELYPTERIS NOVEBORACENSIS (L.) Nieuwl.

Syn. *Aspidium noveboracense* (L.) Sw., *Dryopteris noveboracensis* (L.) Gray.

Near Greystone, Greene County, June 24, 1928, Anderson and Jennison, 1066.

Near top of Gregory's Bald (4000 ft.), Blount County, July 6, 1929, Anderson, 1377.

Foot of Gregory's Bald, Cades Cove, Blount County, June 14, 1928, Anderson, 974.

Thunderhead, Blount County, Aug., 1881, Gattinger.

White Cliff Springs, Monroe County, July 5, 1890, Scribner.

Tullahooma, Coffee County, ————, Gattinger.

Richland Station, Sumner County, Aug. 27, 1883, Gattinger.

Henderson, Chester County, June, 1892, Bain, 163.

Lexington, Houston County, May 20, 1920, Palmer, 17,557.

THELYPTERIS MARGINALIS (L.) Nieuwl.

Syn. *Aspidium marginale* (L.) Sw., *Dryopteris marginalis* (L.) Gray.

Very abundant; a conspicuous feature of rocky woodlands throughout East Tennessee.

Trail to Abram's Falls, Cades Cove, Blount County, June 15, 1928, Anderson, 1010.

Near Greystone, Greene County, June 24, 1928, Anderson and Jennison, 1064.

Mt. LeConte, Gatlinburg, Sevier County, Oct. 2, 1927, Anderson, 609.

Pinnacle Mountain near Greenbrier, Sevier County, Oct. 9, 1927, Anderson, 693.

Lookout Mountain, Hamilton County, ————, H. W. Ravenel.

White Cliff Springs, Monroe County, June 29, 1890, Scribner.

Frog Mountain, Polk County, Aug., 1878, Gattinger.

River Bluffs, Knoxville, June 24, 1897, Ruth, 561.
Whiteside, Marion County, July 7, 1867, Gattinger.
Snail Shell Cave, Rutherford County, July 4, 1891, Bain.

THELYPTERIS GOLDIANA (Hooker) Nieuwl.

Syn. *Aspidium Goldianum* Hooker, *Dryopteris Goldiana* (Hooker) Gray.

Cowan, Franklin County, Gattinger.
Roane Mountain, Carter County, C. Chickering (Gattinger's Collection).

THELYPTERIS SPINULOSA (O. F. Muell.) Nieuwl. var. INTERMEDIA (Muhl.) Nieuwl.

Syn. *Aspidium spinulosum* (O. F. Muell.) Sw. var. *intermedium* (Muhl.) Eaton, *Dryopteris intermedia* Gray.

In the great deciduous forests of the Smoky Mountains this fern is ever present. On such of the crests as are covered with evergreens it gives way to *Thelypteris spinulosa* var. *americana*. So far as our records show, it does not grow in the Cumberlands, or anywhere outside the Alleghany Mountains. Sadie Price (1901) reports it from Tennessee without other reference to locality.

A notable specimen is one from near the top of Gregory's Bald, in a park-like growth along the Tennessee-North Carolina state line. This specimen became very fragrant in drying.

Several variously named specimens in Gattinger's collection seem to belong to this variety. These are in the Tennessee herbarium and are not included in the following list.

Top of Gregory's Bald, Cades Cove, Blount County, July 6, 1929, Anderson, 1376.
Tipton's Sugar Cove, Cades Cove, Blount County, June 14, 1928, Anderson, 983.

Along Roaring Fork, Gatlinburg, Sevier County, June 10, 1928, **Anderson, 957.**

Pinnacle Mountain, near Greenbrier, Sevier County, Oct. 9, 1927, **Anderson, 680, 692.**

Mt. Le Conte, Gatlinburg, Sevier County, Oct. 2, 1927, **Anderson, 607, 608.**

Wolf Creek, Cocke County, Aug., 1890, Ruth, 562.

Wolf Creek, Cocke County, May 13, 1893, Kearney.

THELYPTERIS SPINULOSA (O. F. Muell.) Nieuwl. var. AMERICANA (Fischer) Weatherby.

Syn. *Aspidium spinulosum* (O. F. Muell.) Sw. var. *dilatatum* Am. authors in pt.

Dryopteris spinulosa (Muell.) Ktze. var. *americana* (Fisch.) Fernald.

In the AMERICAN FERN JOURNAL (1928) Clarkson discusses the habitat of *Dryopteris dilatata* and *D. dilatata* var. *americana*. He concludes that these ferns grow in temperate rather than in alpine climates. The occurrence of the broad-leaved spinulose fern on the high mountains of East Tennessee seems to bear out this conclusion. The winters are cold and the altitude insures cool summer weather. In the same issue of the AMERICAN FERN JOURNAL R. C. Benedict asks if "cool and damp" is not a proper climate for this fern. Clarkson's statement and quotation of various authorities as to the occurrence of *Dryopteris dilatata* in the British Isles, Denmark, Alaska, Selkirk Mountains, Vancouver, etc., seems especially significant. All of these regions are noted for their humidity and the frequent occurrence of fog. The Great Smoky Mountains get their name from the same characteristic. The annual precipitation there is relatively high, there is much snow in winter, and the summits may be wrapped in fog at any season. The high ridges where *T. spinulosa* var. *americana* abounds are apt to be miry even in summer. Moreover, it occurs

only on these high, wet ridges among the balsam and spruce trees, rather than on the better drained slopes with the deciduous forests. It would seem that the occurrence of this fern in the Great Smoky Mountains bears out Benedict's statement that fog is an important factor in its growth.

Top of Mt. Le Conte, Gatlinburg, Sevier County, Oct. 2, 1927, **Anderson, 603.**

Top of Mt. Le Conte, Gatlinburg, Sevier County, Oct. 14, 1928, **Anderson, 1123.**

Top of Clingman's Dome, Tenn.-N. C. State Line, Sevier County, July 21, 1929, Anderson and Jennison, 1417.

THELYPTERIS HEXAGONOPTERA (Michx.) Weatherby

Syn. *Phegopteris hexagonoptera* (Michx.) Fée.
Dryopteris hexagonoptera (Michx.) C. Chr.

Roaring Fork, Gatlinburg, Sevier County, June 10, 1928, Anderson, 951.

Tipton's Sugar Cove, Cades Cove, Blount County, June 14, 1928, **Anderson, 987.**

Chilhowee Mts., Blount County, August ——, **A. H. Curtiss,** 3733.

Bluffs near Knoxville, Oct. 11, 1927, Anderson, 697.

Whiteside, Marion County, July 6, 1867, Gattinger.

Joelton, Davidson County, July 16, 1922, Svenson, 106.

Hollow Rock Junction (now Bruceton), Carroll County, Aug. 27, 1922, **Svenson, 359.**

Henderson, Madison County, and Jackson, Chester County, June 1892, **Bain.**

POLYSTICHUM ACROSTICHOIDES (Michx.) Schott

The Christmas fern is plentiful in all parts of Tennessee, much more so than the number of specimens indicates. In "Ferns of Tennessee" I suggested the possibility of the occurrence of the holly fern in that State. This was based on a much toothed specimen of *P. acrostichoides* from southern Kentucky, which was

incorrectly identified as *P. Lonchitis*. The occurrence of the holly fern so far south is very unlikely.

Foot of Gregory's Bald, Cades Cove, Blount County, June 14, 1928, Anderson, 972.

Roaring Fork, Gatlinburg, Sevier County, June 10, 1928, Anderson, 948.

Mt. Le Conte, Gatlinburg, Sevier County, Oct. 2, 1927, Anderson, 611.

Near state line, Gregory's Bald, Cades Cove, Blount County, July 6, 1929, Anderson, 1380.

Cave Spring, Hamilton County, ————, 1850, Gattinger.

Forked Deer, Haywood County, June 14, 1893, Bain, 165.

Jackson, Madison County, and Henderson, Chester County, June, 1892, Bain.

(To be continued.)

Recent Fern Literature

Domin, Karel. The Pteridophyta of the Island of Dominica.

One of the most scholarly students of ferns of the nineteenth century, Karl Presl, lived and worked at Prague, in what was then known as Bohemia, a part of the Austro-Hungarian monarchy. Now at the same headquarters, under the Czecho-Slovakian republic, another botanist, Karel Domin, is studying and writing about ferns from a thoroughly scientific view-point. His most recent publication is a large-paged volume of 265 pages, with 40 full page plates, dealing with the "Pteridophyta of the Island of Dominica," and including a considerable discussion of the geographical distribution of ferns of the Caribbean region.

Dominica is one of Leeward islands, or Lesser Antilles, in the chain which includes Martinique, and is located near the coast of South America. Its fern species are numerous, some two hundred and seventy, classified in

forty-eight genera and nine families. Professor Domin calls attention to the fact that the record for the largest number of species, formerly credited to the island of Jamaica with 500, has now been surpassed by San Domingo, or Hispaniola, with 540, according to the studies of Urban of Berlin. Dominica is a much smaller island, but with its high mountains and abundant rainfall, it offers ideal conditions for tropical ferns—abundant moisture, warmth, and high humidity. The publication reports a rainfall, varying from seventy to four hundred inches per year, according to location in relation to prevailing winds. A downpour of fifty inches in one night is attested. For comparison, the forty-three inches per annum in the region of New York City may be cited.

The publication is of general interest because of its scholarly consideration, not only of the fundamental taxonomic problems, as of generic and specific limits, but also from its consideration of problems of geographic distribution. For the average member of the Fern Society, it may serve to heighten one of those underlying ambitions, that some time or other, opportunity will be favorable for a visit to such a fern paradise, and for the actual use of so valuable a publication.—R. C. B.

Northrop, Alice Rich. Through Field and Woodland. Putnam, 1925.

A very interesting volume of general biological interest, and including the story of a number of common ferns, was published in 1925, and is worth a brief review. Many fern students are interested in a wide variety of plants and animals. This book is a very attractively illustrated compendium for such. Biology teachers will find it a source of a multitude of interesting material. The volume was completed after Mrs. Northrop's death by O. P. Medsger.

FERN SPORES STAND 454 DEGREES BELOW ZERO. (Quoted from "The Week's Science.")—Fern spores, which stayed alive, even when frozen to 454 degrees, Fahrenheit, below zero, within six degrees of absolute zero, and within four degrees of the lowest temperature ever obtained by man, have been reported to the Academy of Sciences in Paris, by M. Paul Becquerel. In previous experiments, M. Becquerel has proved that similar spores from a species of the common fern genus called Aspidium could live for months although sealed in a glass tube without either air or moisture. The spores survive even better, indeed, when there is no trace of moisture present than when they are exposed to the ordinary day by day changes in humidity. They seem to pass into a state of suspended animation in which no vital activity goes on but with the germ of life still existing and ready to spring into activity the moment that conditions are favorable. In the recent tests some spores were dried and sealed up in a glass tube in this way and the tube then immersed for eleven hours in liquid helium gas at the temperature of 454 degrees below zero. Removed from this bath of super-cold, warmed, opened and provided with moisture, more than 99 per cent of the spores proved, M. Becquerel found, to be still alive and able to germinate. The tests leave no doubt, M. Becquerel believes, that germs of life could survive the cold of space between the stars or any other degree of cold possible in the universe.

American Fern Society

Report of the Field Trip of the Society at Lake Willoughby, Vermont

What a welcome announcement brought to our attention the summer field trip of the American Fern Society at Lake Willoughby, Vermont! A meeting anywhere in Vermont would be interesting, but one in the vicinity of this beautiful lake and picturesque, as well as botanically famous, section made in instant appeal.

On Sunday evening, the fern lovers arrived at Pisgah Lodge, Dr. E. J. Winslow, the leader of the party, coming over from Barton to join us the next day. Some had come for the love of the out-of-doors and from general botanical interest; some previously had had the joy of finding all of our New England ferns, but relished a renewed acquaintance; others came with the eager expectation of finding for the first time those choice ferns about which they had read, but had never seen in their natural habitats.

From the Lodge could be seen the two mountains guarding, as it were, the entrance to the Lake. Pisgah on the right, we were told, would yield to us *Woodsia alpina*. Hor on the left, somewhere was guarding for us *Asplenium viride*. How interesting to have these two mountains, on opposite sides of the Lake, preserving individually these lovely ferns!

On Monday morning, the neighboring fields, woods, and marl bog were visited. Mrs. Weatherby's sharp eyes were the first to detect *Ophioglossum* in the field opposite the Lodge. This was the first introduction for several of us to the Adder's Tongue. The following were found: *Lycopodium complanatum* (typical), *Botrychium ternatum*, var. *intermedium*, a fine patch of

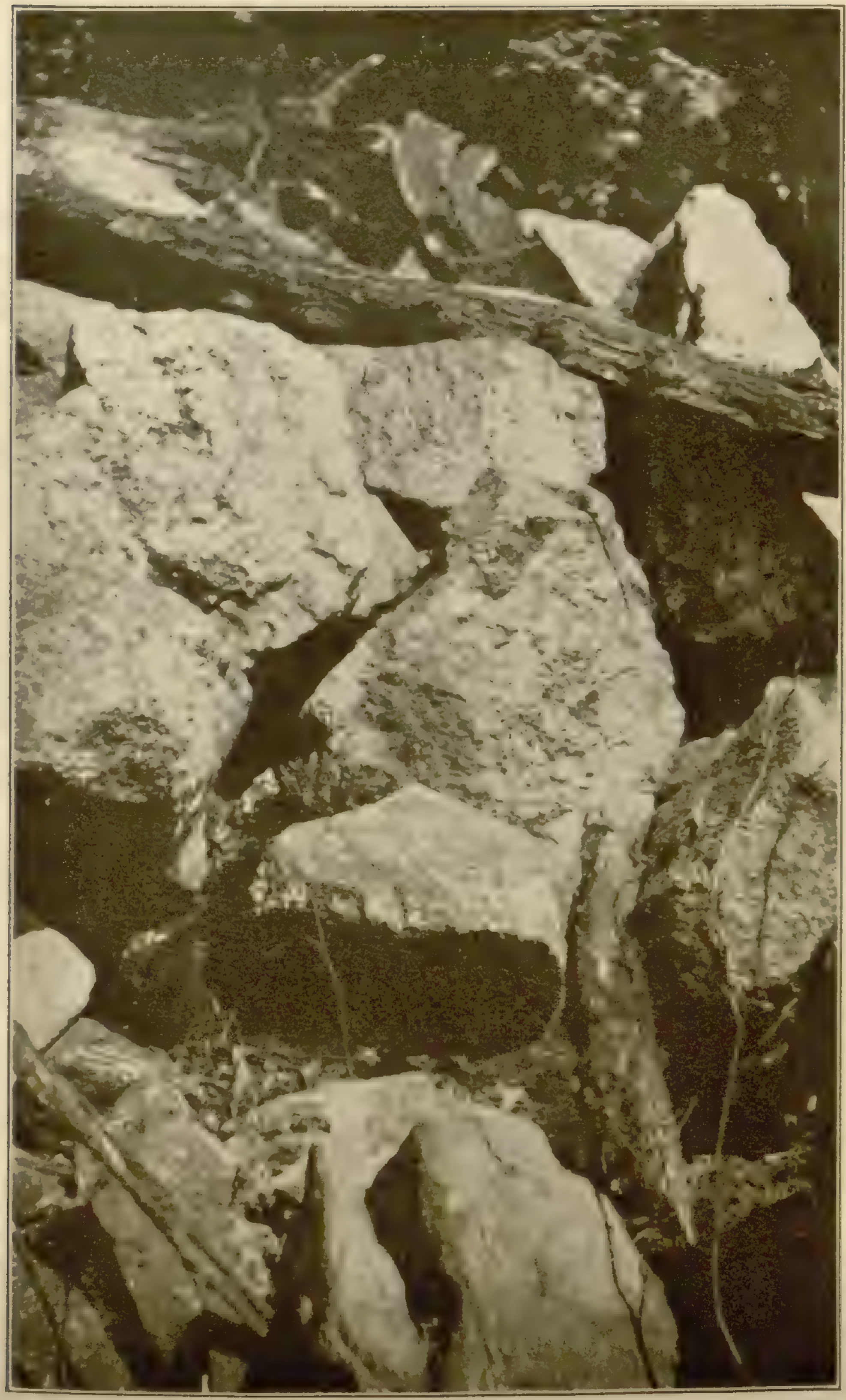
Thelypteris Boottii, around which gathered an interested group, with Mr. Weatherby making clear the distinguishing marks of this fern from those of *Thelypteris cristata*. The usual wood ferns of Northern New England were observed.

Mr. Winslow led on through the woods until we came to a marl bog. He donned rubber overshoes, and stepped out into the water, about three inches deep, followed by others. To their surprise there was no sinking into the soil, but rather a firm footing on white sand. There were no ferns here, but various wood orchids were found.

In the afternoon, *Woodsia glabella* was found decorating the talus of Mt. Pisgah.

On Tuesday, after breakfast, pictures were taken of the group, a cheer was given with botanical terms prominent, and the party was happily off for Mt. Pisgah. A fairly easy grade led us first to a cliff overlooking the Lake. This point gave us a beautiful view of the Lake below, with Mt. Hor on the opposite shore. *Woodsia ilvensis* welcomed us here. We continued to the top where we had lunch and a feast of surrounding country. Mr. Winslow led down the trail part way in order to turn in safely to the cliffs where the coveted find of the day was known to be. A beautiful plant of *Woodsia alpina* was discovered, and soon became the object of study of a joyous and interested group. It seemed especially precious, because no other specimens could be seen. Patient search, however, revealed other alpinas, and a new joy was added to several hearts. Pisgah also gave us *Lycopodium sabinaefolium*, *Thelypteris spinulosa*, var. *americana*, *T. Goldiana*, *Polystichum Braunii*, and some of the rare flowering plants of the region, such as *Saxifraga Aizoon*.

We had heard of the Fern Cave on the western shore of the Lake where recently, men had been found with a



The Alpine Woodsia at Home.

still, making liquor. This cave would probably yield some lovely ferns, though there could be no guarantee of any liquid refreshment other than water. Before breakfast on Wednesday morning, two row boats were pushed off with six or seven members of the party. A half hour's rowing brought us to the cave. A large overhanging shelf, covered with dripping moss gradually revealed its treasures—*Woodsia glabella* and the delicate *Cryptogramma Stelleri*. What a delightful beginning of a new day!

At breakfast, the fern cave was an interesting subject. There was also the eagerness to be off, for Mt. Hor was to be the host that day. Everyone seemed desirous of seeing the *Asplenium viride* which this mountain nurtured. Several years ago, Mr. Winslow had climbed Mt. Hor, and he now led the way, followed by a large group. The trail soon became indistinguishable from the surrounding woods, yet the party went on hoping that the trail might be found later. Finally it was quite obvious that the trail had been obliterated, and that in the intervening years since Mr. Winslow made the trip, there had taken place a logging operation, and the inevitable growth of the woods. It did not seem best for any one to continue unless he wanted to "plough" through the woods hoping eventually to come out below the cliffs. So a large number sat down for lunch, to return soon somewhat disappointed. Mr. Winslow and three others, among whom were Mrs. Drown and Mrs. Miner, continued on.

The four, ably led by Mr. Winslow, pushed their way through shrubs and trees, finally coming out on steep slopes wooded with spruce. The effort was not without its comfort and joy, for well rooted in the rock clefts was found the green spleenwort. To some of us the first

Camp-to-sorus rhizophyllus,
Rah—rah—rah!
Camp-to-sorus rhizophyllus,
There—you—are!
We are fernists, don't you see?
We are happy as can be.
Spores—spores—spores!

impression was that of the maidenhair spleenwort, but coming closer the green stems revealed the true *viride*.

The steepness of the slope here, covered with shallow soil, made us all aware of the ease with which a slide might be started. Certainly a word of commendation is due Mr. Winslow for successfully leading us to the coveted spot without trail, and to Mrs. Drown and Mrs. Miner for courageously and persistently making the trip to the top and back, with no trail. They climbed down

to the top edge of the cliff where, so far as Mr. Winslow knows, no woman ever went before.

While the party were on Mt. Hor, Mrs. B. Preston Clark rediscovered *Botrychium Lunaria*, found at Willoughby many years ago by G. H. Tilton and not since until now. Mrs. Clark's find was not at the original station, but a mile away.

Yes, Wednesday was a great day as were they all. How we desired to linger longer in this picturesque spot, with good companions and our choice ferns!

We are all indebted to Mr. Winslow for his kindness in leading us successfully on all of our trips, and to Mr. Weatherby for his unfailing courtesy, patience, and accurate scholarship.

The members of the party included:

Mr. and Mrs. Beals, Mrs. Boyce, Mr. and Mrs. Clark, Miss Corne, Judge Clarence P. Cowles and son, Dr. and Mrs. Doubleday, Mrs. Drown, Mr. and Mrs. Greene, Miss Griffin, Miss Raska, Miss Kittredge, Mrs. Miner, Dr. Will S. Munroe, Mr. James J. Quinn, Mrs. Slifer, Mr. Stultz, Mr. and Mrs. C. A. Weatherby, Mr. E. J. Winslow, guide.

"QUINMASTER"

Walter Deane, a member of this Society since 1911, and the friend of most of the American botanists of his time, died at Cambridge, Mass., July 30, 1930, aged 83. He was born in Boston, the son of Charles Deane, a local historian of note and a well-known collector of books and prints. He graduated from Harvard College in the class of 1870, thereafter becoming a teacher, first at St. Mark's School at Southboro, Mass., and later at the Hopkinson School in Boston. In 1895, ill health forced him to give up teaching; it was then that he turned especially to science. For some ten years he was in charge of William Brewster's ornithological museum in Cambridge; there-

after he lived an outwardly quiet, but busily occupied, life in a house full of books, pictures, and objects of interest of many kinds.

In 1878 he married Margaret Chapman Coolidge; she died in 1918.

He was a man of many activities; ornithology, Shakespeare, and botany were the chief of them. His botanical interest began about 1883, under the eye, as it were, of Asa Gray, and continued to the end. He was one of the founders of the New England Botanical Club, its president from 1908 to 1911, and for years a member of its Council and of the Visiting Committees of the Gray Herbarium and of the Botanical Museum of Harvard University. He contributed numerous articles to scientific journals. He gathered an herbarium of some 40,000 sheets, remarkable for its collection of seedlings, for the care with which all the specimens were prepared, and for the many critical annotations by botanists whose acquaintance he made as they came to Cambridge—and whose friendship he rarely, if ever, failed to hold. This herbarium, together with his botanical library and collection of portraits of botanists, he bequeathed to the Gray Herbarium.

His was an exceptionally lovable character. No one who knew him will forget his enthusiasm, his warm-hearted friendliness, his cordial and thoughtful hospitality, or the youthful freshness of his interest in most of the doings of mankind.

Mr. Roy Wells, State Forestry, Karioi, North Island, New Zealand, would like to exchange ferns of New Zealand for those of North America.

New members:

Boyce, Mrs. David C., 40 Battle Road, Princeton, N. J.
Cowles, Judge Clarence P., Burlington, Vermont.
Drown, Mrs. Grace L., 9 Walnut St., Barre, Vermont.
Hombersley, Archdeacon A., Port-of-Spain, Trinidad.
Matthews, Mrs. Florence W., 548 Santa Clara Ave., Berkeley, Cal.
More, Miss Eleanor, St. Johnsbury House, St. Johnsbury, Vermont.

Changes of address:

Haas, Dr. Flora A., Arkansas State Teachers' College, Normal Station, Conway, Ark.
Hazen, Edwin H., 91 Howe St., New Haven, Conn.
Kittredge, Miss E. M., Ferrisburg, Vermont.
Wherry, Dr. E. T., University of Pennsylvania, Philadelphia, Pa.

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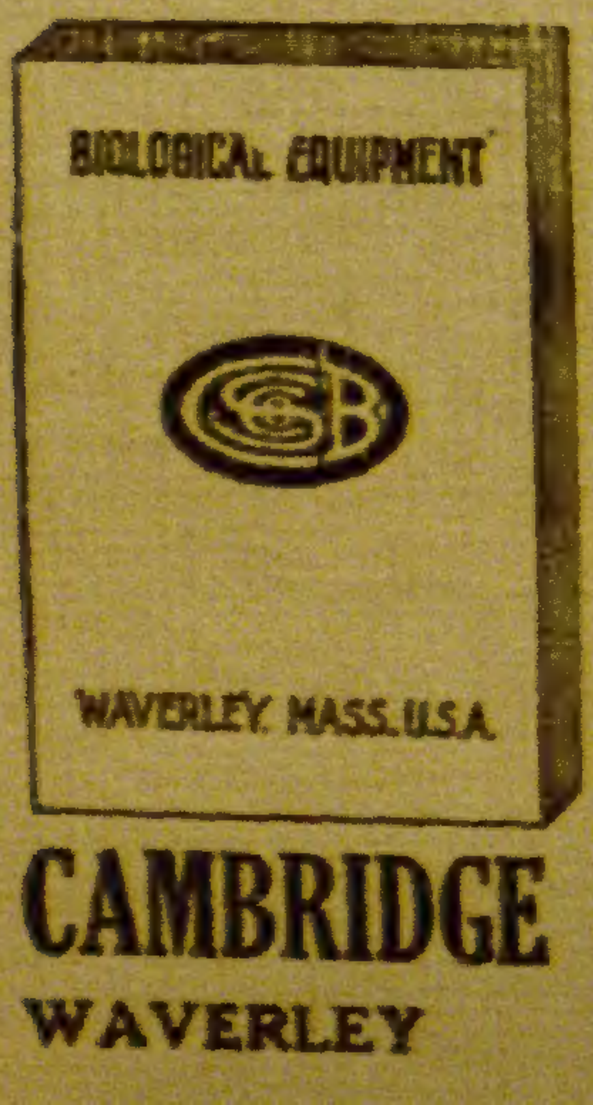

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